A QUARTERLY JOURNAL OF METHODS AND INFORMATION FOR TEACHERS OF SCIENCE

Index

The SCIENCE COUNSELOR

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The Science Counselor

"FOR BETTER SCIENCE TEACHING"

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In Future Numbers . . .

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Inspiring Students to get the Maximum out of the Elementary Chemistry Course
By William S. Haldeman, Head, Department of Chemistry, Monmouth College, Monmouth, Illinois.

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Silicones
By R. R. McGregor, Administrative Fellow, Mellon Institute, Pittsburgh, Pennsylvania.

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Surgical Cotton, From Natural to Finished Product
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The National Geographic Society
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By George Antonoff and Raymond Madrazo Jr., New York City.

The Scientist's Interpreter - The Public Library

• By Josephine F. Priestley

MEMBER SCIENCE AND LIBRARIES COMMITTEE, NEW JERSEY LIBRARY ASSOCIATION, BUSINESS LIBRARY, PUBLIC LIBRARY OF NEWARK, NEWARK, NEW JERSEY

Carefully selected, brief, annotated lists of science books of general interest are published frequently by the New Jersey Library Association as a service to librarians, science teachers, students, and adults interested in science. These six-page book lists receive a cordial welcome wherever they appear.

Librarians in public libraries and in schools consider them of great value in reader assistance. Women's organizations, service clubs, and student societies find them useful.

The lists are inexpensive. This helpful article tells where they may be obtained.

An annotated booklist called *Meet the Sciences* is New Jersey Library Association's invitation to the general reader to visit the public library for answers to such questions as "can plants grow without soil?", "who discovered the new wonder drugs?", "how can you forecast the weather?", and "will space ships ever reach the moon?" This reading list of fifty titles of non-technical science books, intended for the lay reader, is now in its fourth edition and over 90,000 copies have been distributed by public libraries from Maine to California.

The advent of the atomic era has made man curious about the universe whose existence he had always taken for granted. In response to pleas from librarians for titles of "books about mathematics for non-mathematicians" and "works on chemistry anyone can understand," the New Jersey Library Association, in January, 1947, appointed the Committee on Science and Libraries to formulate a long term program of stimulating reader interest in science. Six months later this group published the first edition of *Meet the Sciences*, which is intended to serve as a basis for book purchase by the librarian and book selection by the reader. Subsequent editions were issued in 1948, 1950, and 1951.

In compiling these lists, the committee has had the advice and criticism of science editors, book publishers, and numerous librarians who have submitted lists of what, in their opinions, are the "best" current science books. All but nine books on the lists have been published since the end of World War II. A brief annotation gives a clue to the content and style of each book. The lists are available from New Jersey Library Association Distribution Committee, 34 Commerce Street, Newark 2, New Jersey. Prices for quantity orders are on a nominal basis.

Successive editions of this six page booklet, with appropriate cover page for each issue, have been uniform in design and typography. It has been the intention of the committee to convey to the reader the idea of continuity. A basic aim of all reader guidance is to awaken an anticipation "of books to come." There has been an effort to include the outstanding science books of the preceding year, although selection has been partly based on questionnaires to librarians regarding "reader interests." The latter explains the inclusion in the last edition of such books as Floherty's *Television Story* and Musselman's *Get a Horse!—Story of the American Automobile*, which many would not consider science books in the strictest interpretation of the term.

Classification of books on the list has not been according to arbitrary definitions of "chemistry," "physics," and "medicine." Rather, there has been a choice of sub-headings to capture the imagination and attention of potential readers. Sub-titles of the 1951 edition of *Meet the Sciences* are "Wellsprings of Knowledge," "Conquest of Earth, Sea and Air," "Mystery of Life Processes," "Magic Properties of Matter," and "Science Serves Man."

Carefully phrased in non-technical language, most of these books aim to explain to the person of average education, scientific phenomena and their effect on the social environment. On the cover of the 1951 edition, a quotation from a speech by David E. Lilienthal well expresses the philosophy underlying such projects in reader guidance. In 1946, he told the American Library Association that "dissemination and application of knowledge . . . of how science and technology can be used is at the very core of our modern opportunity to put science to work for human well-being."

In the current reading list, the potentialities of scientific discoveries for human welfare are emphasized in books like Marguerite Clark's *Medicine on the March* and Jacob Sack's *The Atom at Work*. Archaeology and mathematics lose their frightening effect when described in Ceram's *Gods, Graves, and Scholars* and Hogben's *Mathematics for the Million*. That the inspiring lives of scientists may best explain their discoveries is demonstrated by such biographies as physicist Millikan's *Autobiography* and Thomson's *Harvey Cushing*, and collections of biographical sketches like Jaffe's *Crucibles: The Story of Chemistry* and Paul Oehser's *Sons of Science*. Also listed, is Lincoln Barnett's *The Universe and Dr. Einstein*, explaining in simple language, the theories which have changed our concept of the universe.

It need hardly be said that the last edition of *Meet the Sciences* includes Rachel Carson's *The Sea Around Us*, but it also reminds readers that two other excellent books on the same subject are *The Living Tide* by N. J. Berrill and *The Sea and Its Mysteries* by J. S.

(Continued on Page 140)

Demonstrations of Bacterial Inhibition

• **By Sister M. Muriel. Ph.D.,** *(University of Pittsburgh)*
DEPARTMENT OF BIOLOGY, SETON HILL COLLEGE, GREENSBURG, PENNSYLVANIA

This paper explains how worth while experiments in bacterioloy can be performed by high school classes. Expensive equipment is not required for the performance of simple but interesting demonstrations of bacterial inhibition.

Here is practical help for the busy teacher.

This paper was presented before the Biology Section of the Pittsburgh Diocesan Science and Mathematics Teachers Association.

●

The world of microscopic organisms includes an almost incalculable number of bacterial and viral representatives. The useful contributions of many of these are well recognized in the industrial, agricultural, and domestic fields, whereas many other forms of the same type of organisms attract an equal if not a greater amount of attention by the role they play as causative agents of disease. It is the latter group that I shall discuss. Present day advertisements are constantly indicating the relative therapeutic and prophylactic values of various germicidal and antibiotic substances. I, therefore, consider it of practical value to suggest some simple techniques which may demonstrate these germicidal and antibiotic properties to high school students.

We begin by recalling the definitions of the terms germicidal and antibiotic. We generally regard as germicidal those chemical agents that exert a destructive effect upon microorganisms. In relation to pathogenic organisms they may be considered as substances which are applied externally and locally to destroy such organisms. Antibiotics, on the other hand, may be interpreted as extracts obtained from living organisms which may be effective in bringing about the destruction, or for the most part, the retardation of microbial activity until the normal combatting agents of the body can accomplish their specific roles.

To make these suggestions of practical value, various basic bacteriological techniques require comment. Many teachers think demonstrations in bacteriology must necessarily require expensive equipment. Let me enumerate what may be considered as a minimum and yet workable amount of apparatus. In some cases the chemistry or physics laboratory, if separate laboratories are equipped, may have some type of oven which may be used for the sterilization of glassware, viz: test tubes, and Petri dishes. If this is not the case, it may be possible to purchase a single-burner oven which can be used for that purpose over a bunsen burner or hot plate. A small pressure cooker, approximately a two or four quart size which may be purchased at a department or hardware store will provide adequate apparatus for the necessary sterilization of culture media preparatory to demonstrations, or for the preliminary steps in the cleansing of glassware used for these demonstrations.

Emphasis should be placed upon sterilization procedures in all bacteriological techniques. Such emphasis will indicate to the student the significance of the various aseptic techniques and sterile conditions which are provided for in surgery.

The culture media may be restricted to nutrient agar, flake agar, nutrient broth and dextrose. As a matter of fact, these may be reduced to nutrient broth, and flake agar since these form the basis media for the types most generally used. Dextrose may be added to the nutrient broth medium in the required concentration, usually 1 per cent. Most bacteria, with the exception of those which require a selective medium, will grow quite abundantly on such a diet. These materials may be obtained in ¼-lb. quantities from most supply houses. If flake agar is used, it should be added to the nutrient broth, thereby providing a solid medium for plating or agar slants. Liquid media, viz. nutrient broth or dextrose broth, may be used for stock cultures of both bacteria and molds. The molds will thrive best on carbohydrate media.

The high school teacher may be faced with the problem of obtaining culture material. All kinds of cultures may be obtained from bacteriological supply houses at prices ranging between $1.50 and $2.50 per tube. If your budget permits the purchase of these cultures you will, of course, be assured of the purity of the culture and will not have to spend time in testing for purity in your own stock supply. However, since we are interested in this discussion primarily from an economic standpoint, may I suggest methods of preparing your own cultures.

The pathogenicity of the staphylococcus group makes them convenient organisms for demonstration, and their ubiquity makes it possible to obtain these forms in pure culture by the following simple device. Finger prints are made over the surface of a previously prepared, sterile agar plate. This is prepared by pouring melted agar into the bottom of a Petri dish and allowing the agar to solidify. The plate should then be incubated for twenty-four to forty-eight hours, if you are fortunate enough to have an incubator, or allowed to develop at room temperature. These organisms are very accommodating, they are neither fussy about their diet nor reasonable fluctuations in temperature. Within the specified incubation period small white or yellowish colonies will most likely appear on the plate. A simple bacteriological stain such as gentian violet, followed by microscopic examination, will establish the identity of these organisms, and at the same time confirm the purity of culture. Transfers should then be made by means of an inoculating loop either onto an agar slant or into dextrose broth.

Mold cultures of *Penicillium*, which is the particular mold from which the extract penicillin is obtained, may

be grown first on citrus fruits. Oranges or lemons can be placed in a tin can for a few days, and the spores already present on the skin of such fruit may germinate under these conditions. A bluish-green mold indicates that this particular mold has progressed to the fruiting stage. The high power of the microscope will reveal the characteristic branching of the fruiting bodies. Of course, some other types of molds may be developing simultaneously along with *Penicillium*. The color of the fruiting bodies will differentiate these for the most part. Care should be taken in the transfer to obtain the inoculum from that portion of the fruit which shows no apparent macroscopic contamination. In the flask of dextrose broth, the fungus should develop as a heavy blue green surface growth. These two types of culture material, the staphylococcus culture and the mold culture, should afford ample material for several interesting demonstrations which I shall now describe.

All of us are aware of the bactericidal effects of different chemicals. You feel quite confident that many preparations containing silver salts, or the special kind of cough drops wrapped individually in tin foil, may reduce bacterial infections. Here is a simple, and yet conclusive demonstration of this particular point. A silver coin is thoroughly cleansed by scrubbing it with soap and water, and then immersed in a weak solution of hydrochloric acid, followed by rinsing and subsequent immersion in 70 per cent alcohol. The coin is then placed in a Petri dish; a heavily seeded melted agar is poured over it; and the agar is allowed to solidify. The seeding of the agar is accomplished by stirring a few loopfuls of the staphylococcus culture into the melted agar.

Another interesting and likewise conclusive demonstration of the germicidal effects of certain chemicals is the so-called "spot test" for bacterial inhibition. Our standard staphylococcus culture is used again. A seeded plate is prepared and several germicidal agents are applied by means of a glass rod or on glass beads to either different sectors of the same plate or to different plates. This experiment affords an opportunity for the study of the relative potency of various agents. Students may be interested in testing the antiseptic or bactericidal qualities of some substances of their own choosing, either in the nature of solutions or ointments, so that the experiment should not be restricted to such agents as will undoubtedly give positive results.

It will be decidedly to the point to demonstrate the fact that all solutions to which high germicidal potency is attributed may not always have so high a coefficient. The three agents I have selected should be fairly representative. The qualities of Lysol and gentian violet need no comment; Merthiolate and Metaphen are well recognized as antiseptics. Iodine, S.T. 37 or hexylresorcinol, formaldehyde and related forms will give similar results. The presence of inhibitory zones in the areas to which the chemicals were applied indicate positive results. It should be noted that no attempt is made to determine quantitative results.

The role of antibiotics in microbial activity is a subject of vital current interest. The long list of antibiotics is increasing daily. Were I to make any comments on the relative potency of these they would involve discussion far beyond the allotted time. For that reason I have selected as the antibiotic to be used for demonstration, the classic example of penicillin, since it was the first to be prepared commercially on a large scale. For demonstration purposes some of the mold may be transferred directly from the flask to a seeded agar plate, or small amounts of a solution of a penicillin tablet (a tablet containing 100,000 units dissolved in 5 c.c. dist. H_2O) may be applied either by the "spot test method" or by means of small glass cylinders to the seeded plate. Inhibitory zones should be demonstrated on the seeded plates. Specifically, the cylinder method is comparable to the cylinder plate method used to determine the strength of the solution interpreted in Oxford units. The Oxford unit is the amount of penicillin (equivalent to 0.6 milligram of pure sodium salt of Penicillin G) that will produce a 24 mm. zone of inhibition on a seeded plate with a standard strain of staphylococcus.

I hope that this short discussion on techniques to demonstrate bacterial inhibition may have convinced you that experiments in bacteriology can be executed in high school laboratory work; that such techniques do not require a large amount of expensive equipment; that the general principles of bacteriological inhibition may be demonstrated by comparatively simple experiments; and finally, that the visible demonstration of the activity of these microorganisms may develop in the students of science a greater reverence for the majesty of the Creator as reflected in the vitality of these organisms—the smallest of His creatures. ●

SUGGESTED LIST OF MINIMUM APPARATUS AND MATERIALS

CULTURE MEDIA

Nutrient Broth
Dextrose Broth
Nutrient Agar

¼ lb. of each of these will provide stock material for several years.

The following indicates the relative concentrations in which these materials are used:

Nutrient Broth — 8 gms. per liter of Dist. water
Nutrient Agar — 15 gms. per liter
Dextrose Broth — 23 gms. per liter

250 cc. should be an average amount of culture media to prepare for most demonstrations. 10 cc. per tube may be considered an adequate amount.

Prepared Agar tubes may be purchased at an approximate cost of $2.50 per dozen. The average cost of the Difco Standardized Dehydrated culture media may be approximately $2.00 per ¼ lb.

EQUIPMENT

1 doz. Petri dishes — (60 mm. diam. x 15 mm. height of upper dish) Test tubes.
6 to 12 fermentation tubes — with or without bases (the approximate difference in cost will be about 10c).
2 inoculating needles — holders are purchased separate. Chromel wire No. 26 gauge may be obtained in coils.
1 wire test tube basket 4" x 2½" x 5" or 6" x 6" x 6".
3" x 1" glass slides.
Gentian violet or Methylene Blue stain — if purchased in 10 gm. amounts will provide an indefinite supply.
Gentian violet Solutions (Hucker's Modification for staining bacteria may be purchased in 4 oz. quantities).
1 Pressure Cooker.
1 small single burner oven (12" x 12" — approximate cost $2.50).

SUPPLY HOUSES — General Biological Supply House.
Carolina Biological Supply Company.

ADDITIONAL DEMONSTRATIONS IN BACTERIOLOGY

1. Oral swabs stained with Gentian violet.
2. Collection of microorganisms from the atmosphere on agar plates.
3. Collection of organisms from the surface of the skin.
4. Culture obtained by inverting drinking glass on agar plate.
5. Estimation of the number of bacteria in 1 cc. of contaminated pond water.

It's a Colorful Life

• By Norman F. Barnes
GENERAL ENGINEERING LABORATORY, GENERAL ELECTRIC COMPANY, SCHENECTADY, NEW YORK

You will find in this delightful article a wealth of interesting information about the use of color in nature, art, industry, and the home.

Dr. Barnes discusses in a light mood the What, the How, and the Who of color. Many of his observations will be new to you.

Learn why the green light in traffic signals is more blue than green, why the color bands of the French flag are of unequal width, why axes have red handles, and why persons develop an increased liking for blue as they grow older.

Under the subject *It's a Colorful Life* we could, I am sure, discuss a number of topics including some of the antics of the unpredictable human race. And I am equally positive that most of these subjects would not really belong in THE SCIENCE COUNSELOR. However, there is one phase which is at home here, and that has to do with the science and use of color.

We have all been impressed with the brilliant dazzle of the neon-type signs in our modern business districts, with the flashy colors of fireworks displays, with the beautiful green of nature's chlorophyll, and with the amazing number of colors in paints and fabrics, and even food. Why some of these colors appear as they do is a question we might well try to answer.

The color appearance of the clothes we wear, for example, and the flowers we see is largely the result of the effects of three factors. I like to call these the *What*, the *How*, and the *Who* about color. Together, these three effects will determine what you and I see as far as color is concerned when we look at an object. Broadening the What factor we might say, "What are the physical characteristics of the material which are responsible for its appearing red, for example?" In other words, if white light from the sky falls upon a red rose, there are certain physical characteristics of the rose which permit only red light to be reflected by the petals to our eyes. These physical or reflecting characteristics of materials can be measured scientifically and used to provide a means of color standardization and control in countless fields from false teeth to house paint.

Turning now to the How factor we can ask ourselves, "How do we look at the sample?" Do we look at the material under the somewhat yellowish tungsten lights in our home or do we look at it outside in the daylight where the light itself is bluish in color? By looking at suits and ties both inside and outdoors, I think that we realize that the type of illumination may very well affect the color appearance of an object. Have you ever noticed your companion's complexion when you were driving along a bridge or highway illuminated by the yellow sodium lamps? It's quite ghastly, isn't it? And if you've ever looked at a juicy beefsteak under mercury light, you'll never want to eat one again. On the more pleasant side—and still talking about food—a mid-west cafeteria doubled its sales of salads by serving them on green plates instead of white ones, creating the illusion of larger and greener salads.

Finally, we consider the Who factor. If a person is color blind or didn't get out on the right side of bed or is ill, all these factors may affect his color vision. Some 10 per cent of our male population and four per cent of our young ladies have some form of color blindness. In many of these cases the individual is unable to distinguish red from green. However, if the green is actually blue-green, many of these people can see a color difference. Hence the green light in our traffic signals is often more blue than green. Oh yes, and when you're matching colors don't lie down on the job. When you are standing upright, both eyes see colors about the same way; but when you are lying down on your side, the lower eye is more sensitive to red and the upper to blue.

In the animal kingdom, which of course includes ourselves, colors are produced in two ways. One type of color is formed through the use of pigments or coloring material and the other as a result of a physical structure of the substance. Thus, in the latter case, the iridescence on the inside of a sea shell is produced by very thin films of lime, for example, and the brilliant green color of many beetles is produced by a particular physical structure rather than a pigment. The colorful oil film on a wet street is a good example of structural or physical coloration, there being, of course, no dye or pigment in the oil itself.

In the group of pigment colorings for animals there are four main types. The color chlorophyll, which is probably the most familiar pigment the world over, occurs in some animals as well as being profusely present in the plant world. The red blood pigment hemoglobin is found not only in the vertebrate animals or animals with backbones, but also in certain earthworms and marine worms. The third group of pigments includes melanin which is produced in the skin in the process of sun tanning, for example, and which is responsible for the black, sinister appearance of the crow. Two yellowish pigments are also of interest. Carotene gives the yellowish color to butter as well as to our skins, and the xanthophyll coloring found in plants also colors the yolks of birds' eggs.

The use of color finds many applications in the animal world. The white of the snowy owl, the green of insects and worms, and the brown of the desert lizard all are colors which help to conceal the animal in its natural surrounding. Though most of these and similar colors are permanent, some are seasonal and some only

momentary. In many cases startling, conspicuous colors have served as a warning by certain unpalatable insects, frogs, lizards, and even birds. Still other uses of color include recognition, particularly among the higher animals such as birds and mammals. The cottontail of the rabbit is probably a good example of such a use. And of course we're all familiar with courtship colors—the luridly colored claw of the fiddler crab, the brightly colored male spiders, and the beautiful plumage of the peacock.

There are a number of unusual facts and superstitions in the field of color which are most interesting and often quite amusing. For want of a better word I've given these color oddities the name of "Colorisms." In India, for example, the natives paint the walls of their huts blue in order to scare away lurking tigers, while the same color is used on fence gates by the Pennsylvania Dutch to indicate a marriageable daughter within. In the early days of the eighteenth century there were a number of groups of people called "Bluestockings" who had strong learning or literary tastes. If any of these groups still exists in Boston, that city could claim both the Boston Bluestockings and the Boston Red Sox.

We've all heard that cool colors recede while warm colors appear closer. Such an illusion is actually well based on scientific facts. Optical images of a red and a blue object will be formed in different places in the eye and the objects themselves will therefore appear to be located at different distances from the eye. Furthermore, if the red and blue objects are actually the same size, the red object will appear to be smaller than the blue. It is for this reason that in the French national flag the three vertical bands of red, white, and blue are not of the same width. In order for these bands to appear to be equal in width the red is 23 per cent or almost one-fourth greater in width than the blue, while the white is 10 per cent greater in width than the blue.

Most of us have interesting associations for each color. White, for example, calls to mind purity and cleanliness. Hence this color is widely used in hospitals and in the food industry. A white rubber conveyor belt for food or white rubber gaskets in food processing machinery looks far cleaner than its black counterpart possibly could. Red often reminds us of strength and vigor. A man shopping for an axe will buy it without question if it has a red handle, but if the handle is peach colored—well, he just won't have anything to do with it. The blues and greens are referred to as the cool colors. Green itself is actually the easiest on the eyes, to use a familiar expression. This results from the fact that the sensitivity of the eye is greater for the color green and less for other colors in the rainbow. Because green is easiest on the eyes, it is often used as the decoration color in hospital psychopathic wards.

The favorite color of children is red, but with maturity a greater and greater liking for blue gradually develops. This is due to the fact that the fluids in the eye become yellowish with increasing age. It is characteristic of such a yellow coloring that it absorbs blue. Consequently, as one grows older he is able to see less and less blue light and therefore seems to develop a thirst or preference for blues.

Mail order stores often run into difficulty over certain color names. "Nude," which has been a common color name for decades still seems to offend the sensibilities of some people and it is not uncommon to have the merchandise so-named returned. The name "Flesh," however, seems to be well accepted. The same thing happens to colored goods called sapphire, but for a different reason. The last syllable sounds like "fire," and so there are many people who expect to unwrap a fiery-red article, only to be greatly disappointed in finding the material colored blue. And then there are names which allow the imagination to run wild—Elephant Pink, Twinkle Gold, Peach Whip, Melon Heart, Blueberry Mauve, Florida Surf, and Hot Tangerine. Some of the colors sound good enough to eat!

A new science of color conditioning is rapidly growing in this country. In the home, colors are widely used to set moods and fit the personalities of the family. In the factory colors are finding wide acceptance in providing better working conditions and surroundings and in greatly reducing accident rates. In a typical safety color code red marks fire protection equipment; orange indicates hazards which might cut, crush, burn, or shock; yellow shows stumbling or falling hazards; green, first aid equipment; blue, caution; and white, gray, and black serve as housekeeping and traffic control colors.

Yes, the use of color in art, industry and the home combines with the colors in nature to say that it is indeed a colorful life. ●

★ ★ ★ ★ ★

"It is true that we cannot all be fountains of energy and novelty throughout every day, but we ought, if we are teachers, to be so keen on our own subjects that we can talk interestingly about unusual aspects of them to young people who would otherwise have been dully neutral, or—worse—eager but disappointed. A teacher must believe in the value and interest of his subject as a doctor believes in health."

—GILBERT HIGHET
The Art of Teaching

★ ★ ★ ★ ★

"If we understand what democracy is and what leisure is, and that to be a free man is to be a man of leisure as well as a citizen, then it follows that all children not only should go to school but should also be given a liberal education there. I would go so far as to say that all vocational training should be removed from the schools. I would go even further and say that by liberal education for all children I mean the same kind of education for all, up to what is now regarded as the Bachelor of Arts degree."

—MORTIMER J. ADLER

Utilizing Home and Community Resources in Elementary Science Teaching

• By Anne Hopman
ELEMENTARY SUPERVISOR, PUBLIC SCHOOLS, FORT WAYNE, INDIANA

The sound sense and broad experience of the writer are reflected in this paper.

The school must not be the sole teacher of science. Both home and community should cooperate if the teaching is to be effective. The most valuable resources are found outside the classroom.

Teachers of elementary science will be stimulated by this article.

There are many opportunities in the teaching of science in the elementary grades to utilize home and community resources. In fact, if the program in science is functional, we will recognize that it is impossible to teach science without making use of the resources found outside the classroom. We recognize that we teach one child, and that this child lives in the school, in his home, and in the community. The school is in a strategic position to unify and integrate these experiences.

If we listen to children, we are aware of this close relationship of the school, the home, and the community.

"I can help with our school garden. Mother and I have a garden at home."

"My dad and I talk at home. He has his own ideas. I tell him ideas I learned at school. It makes a nice arrangement."

"We drove to the airport Sunday. We saw the Weather Bureau. What are those instruments on top of the building?"

Thus, children give evidence that science functions in their lives in the home and in the community. They indicate not only their interest in science, but also offer suggestions for available resources.

Guides for Effective Use of Home and Community Resources

How can we as teachers make effective use of the resources available in the home and in the community?

1. We need to recognize that the home and the community furnish the basis for children's attitudes, ideas, and understandings in science. Children come to school with a definite background on which to base school experiences. It is important that we know the child and his home in order to be cognizant of the attitudes and experiences in the child's background. We must have a respect for the child and his family and for the child's expression of experience. The expression of concepts gained through family experiences may initiate a classroom study, as is illustrated in the following example.

A third-grade class was discussing the cause of day and night. One child offered the idea that the sun goes around the earth. Jack challenged that idea with the statement, "The earth goes around the sun, and the sun goes around a star." When asked how he knew this, he replied, "My grandfather told me. He knows lots about this. He once knew real scientists." The teacher wisely did not challenge Jack's statements, but did stimulate him to further inquiry. She asked Jack to discuss these ideas with his grandfather and to report to the class on the help he received. This suggestion resulted in Jack bringing to school a letter and a book from his grandfather. In the letter the grandfather explained how he and Jack had many "who-what-when-why" sessions, and that astronomy had been the subject of many of these sessions. He explained the theory which Jack had tried to interpret. He referred to the accompanying book as authority, and offered his help in any way it could be used.

The interest evidenced by Jack, his grandfather, and the other children gave impetus to a study of the solar system, in which the children read, discussed, expressed

THE HOME FURNISHED the materials for these simple instruments or "soundmakers" in this sixth-grade study of sound.

THIS CONSTRUCTION WORKER is helping these fifth-grade children and their teacher learn about the machinery used in constructing an addition to their school building.

their ideas through art and stories, and constructed a mobile of the solar system.

2. We need to be aware that children use their school experiences in their living. Activities offered in the school must be so important to children that they will make use of them in places other than in the classroom. We must offer science experiences that are real to the child, and those which in order to be solved enlist the cooperation of the home and the community.

A sixth-grade class was interested in sound because of a study of ears in health class. They wanted to know what caused sound and how it reached the ears. The children brought sound makers from home. They brought such things as knives, spoons, bottles, and rulers, as well as the musical instruments commonly associated with sound. These materials were used for experimentation and to illustrate the scientific principles read about in their science books. Charles made a sound box with the help of his father. Bob completed a one-string violin which he had started in Cub Scouts. Steve carried his interest about sound into learning more about the telegraph. These three boys enlisted the help of their parents who made contributions of ideas and materials. All through this study, use was made of resource persons, such as the school doctor, the director of instrumental music, and the children's own music teachers.

It was interesting to observe that in this study the children carried their questions, interests, and knowledge into the home. They learned the importance of sounds and responsibilities for producing and controlling sounds. Much interest was created in instrumental music. Appreciation of music was fostered by this study of sound. In addition, the children learned important health concepts.

3. We need to know the community in relation to the resources available, such as materials of instruction, resource persons, and places to visit. Some school systems have a listing of valuable resources that can be found in the community. These resources are listed and evaluated in terms of suitability for age group, and contributions to the curriculum. It is possible for a group of teachers to explore the community together with suggestions to other teachers evolving from the study.

If given the opportunity, children are willing and eager to bring many materials for experimentation from their homes. In fact, it is desirable that the children supply as many of the materials as possible. There are many materials for experimentation that children can furnish such as candles, jars, pyrex dishes, seeds, musical instruments. Sometimes, however, the home makes a unique contribution.

A fifth-grade class was studying the cause of seasons. An experience was planned for the classroom in which a projector light, a globe, and a circle on the floor were used to demonstrate the cause of seasons. Lou Anne came to school a few days later and said that her father was working on a model that would show the same ideas. When the model was finished, the father brought it to school. Lou Anne and her father explained it to the children. The inclusion of the moon on the model promoted questions and study concerning the relationship of the earth and the moon. This model was a contribution from the home that served Lou Anne's class and later classes. It became a part of the permanent science equipment for that school.

IT IS IMPORTANT for children to have constructive attitudes and knowledge about conservation. A county agent is explaining a method of testing soil to these seventh-grade children.

The study of sound in the sixth grade illustrated the valuable contributions that can be made by resource persons. One class enlisted the help of contractors and engineers in learning more about the construction of an addition to their school building. A county agent helped a seventh-grade class understand the dangers of soil erosion, and a district extension forester explained the need for conservation and the importance of forest products. In business, industry, and public service there are many persons willing and able to talk with children. The teacher will seek the help of these resource people when such help is purposeful. Many teachers have found it valuable to talk with the resource person before the class visitation, helping him to learn more about the group of children, their background in the subject to be discussed, and some of the children's questions about this subject.

Places to visit in a community are abundant. However, it is extremely important that the school journey be purposeful and evolve from questions and problems that are of interest and importance to the children.

One fifth-grade class had done much reading, discussion, and experimentation in learning about air and weather. All of their questions had not been answered through this study, and so a trip to the Weather Bureau was planned. The children divided into groups to plan the details. One committee was responsible for checking on available transportation. Another group organized the class questions. A small committee accompanied the teacher on a pre-trip to the Weather Bureau. Individual responsibilities were assigned. The actual field trip was an effective learning experience. The children listened, observed, and asked questions. Discussion, writing, and art work clarified ideas and observations after their return to the classrooms.

This is one illustration of how a place in the community can be used effectively in teaching science. Local parks, woods, nearby farms, industries and public service facilities offer many opportunities for community study.

4. We need to recognize that children's interests make valuable contributions in initiating and promoting science study. One girl recently remarked, "I never thought I'd like to learn about rocks until Marcia brought her collection."

Interests or hobbies in a family may promote special interests of individual children. Children should be given the freedom to share these enthusiasms in the classroom. We need to be opportunistic at this point and capitalize on these interests and organize them for group learning. We cannot afford to say, "It doesn't belong at my grade level," or "I planned to use that study later in the year."

A fourth-grade class had been experimenting with magnets. On their science table were magnets and a shaker of iron dust. Sherrill asked permission to take some of the materials home. With her father, she experimented making various patterns with the iron dust and the magnets. Her father's hobby was photography, and he photographed some of these patterns. Sherrill brought the photographs to school. The children asked questions about the different patterns shown in the picture. In the beginning of this study, the teacher had not planned specific experiences which would promote understandings of magnetic fields. However, the children's questions about the photographs indicated that such experiences would prove valuable. The children experimented and arrived at some generalizations concerning magnetic fields.

5. We need to provide experiences in science that are of social significance and promote ways of working in science that are socially useful. If we as teachers recognize and follow this principle, science will function in the home and in the community. Problems of interest and importance to children have social meaning because they evolve from children's living. The methods children use in solving problems will influence their behavior outside the school. The teacher must assume leadership in organizing children's experiences whether they take place in the school, in the home, or in the community. These experiences can promote growth toward desirable social behavior.

A school faculty recognized that constructive attitudes and concepts of conservation could be realized only through school-community cooperation. Members of a local conservation club were invited to attend one of the faculty meetings. Ways in which school experiences could be used to promote wise use of resources were discussed. This discussion indicated that there were many possibilities for all grade levels, kindergarten through eighth grade. During the school year, the teachers utilized every available opportunity to promote attitudes, habits, and knowledge of conservation. A kindergarten class learned how to care for pets in their classroom and at home. Knowing and caring for winter birds was a second-grade project. The fourth-grade class beautified some of the school grounds with spring and fall flower gardens. The fifth grade social studies program was correlated with a study of conservation. An eighth-grade class made a special study of their own city in regard to water resources, soil conservation for nearby farming areas, park facilities, and scenic beauty.

Throughout these experiences, it was necessary to enlist the cooperation of the home and the community. The children worked through their problems making use of many sources of information, experimenting, and working in groups. The teachers noted increased maturity in scientific attitudes. The projects were important to the children and to the community.

Summary

It is evident that the school, home, and community can become co-teachers of science. It is not only advisable, but it is also essential that these educative agencies work together. Effective teaching of science will not be possible unless we make use of all available resources. Our most valuable resources are found in the home and in the community. Utilization of these resources and cooperation with the agencies that provide them will promote effective science teaching in the elementary grades. ●

Experiences of a Rock Hound

• By Norval C. Hoge
"ROCK HOUND," PITTSBURGH, PENNSYLVANIA

Here in his own plain words is the story of an enthusiastic rock hound.

It brings to light an unusual phase of the jewel industry, showing how "rock" is sought and found.

More and more men are making a hobby of hunting precious and semi-precious stones, cutting, grinding, polishing, and mounting them.

Rock hound clubs are now found in some of the major cities.

A rock hound hunts precious and semi-precious stones because of their beauty or their rarity. Sometimes he gathers rock specimens for collections. A rock hound is often a canny trader. He will buy from others and he will accept tips from scouts, but he prefers to seek rock for himself, collecting his own material.

Rock hounds are called "rock lickers," since they have a habit of licking specimens as they find them. Water is scarce in the desert and the canteen may be close to empty or there may be a long day ahead. Once I was caught alone without water in a canyon in the wilds of Utah. I didn't know the lay of the land well and I became scared, something we are warned not to do. I listened intently and finally heard what I wanted to hear, an irrigation stream. I was almost down and crawling by the time I reached the water. It was alkali water, unfortunately, and I wasn't sure it was safe. So I washed out my mouth and spit out the water, splashed my body with water and then lay in the stream for a while. Finally I was able to walk far enough to reach a ranch house with good water. There it took me a long time to drink a couple of glasses. Now I know the meaning of the song "Cool, clear water."

A rock hound must be a gentleman. He must also be tough. He will mingle with the elite today and the scout tomorrow, and the scouts are often rough men to deal with.

The rock hound must be artist enough to visualize the beauty within a piece of rock. He must know beauty, not only as he sees it himself, but as other men and women will perceive it. He must be able to predict who will like his rock.

The rock hound must be enough of a psychologist to get along well with the people he meets in his travels. When there is a gun in your back you have to think fast and talk fast. You have to know the type of man holding the gun and act accordingly.

One time when I was going on a trip my wife questioned me about a bottle of liquor I carried. I informed her that it was for snake bite. When I returned and she questioned me again I told her we had been watched and followed all the time we were in the mountains. Whenever one of the watchers makes himself known, whiskey is a good peacemaker, even among moonshiners.

Speaking of snake bite—I always wear eighteen inch boots for protection. Potassium permanganate is used by some when a snake strikes and hits. When no such remedy is available a cross is cut into the skin where the snake struck. When it is bleeding profusely the poison is sucked from the wound and spit out.

Doctors and nurses wouldn't approve the treatment, but in case of a cut or a scratch from a thorn or a fall over a boulder, the rock hound puts saliva on the wound just as an animal licks itself when cut. The treatment may not be pleasant to think about, but rock lickers credit it with saving lives.

The rock hound must not get dizzy when looking down from a height. I have stood on a ledge and looked a mile straight down. One must be as sure footed as a mountain goat as he clambers over ledges and down a trail that is no trail. Climbing down is harder than climbing up.

A rock hound must have intuition, a nose for rock. One Sunday I went to San Francisco dressed in my field outfit of boots, rough britches, flannel shirt and slouch hat. Then a hunch hit me. I walked down Market Street to the waterfront and entered a "forbidden" part of the city. There, in a cheap restaurant, I saw the most beautiful rock I ever beheld. Although I had never seen one, I knew at once what it was, an Alexanderite, maroon color under artificial light but apple green in daylight. I didn't get the rock, but merely seeing it made my trip worth while. The rough customer who was wearing it said he had refused an offer of a thousand dollars for it. Knowing the rule of the West I asked no questions.

The up-to-date rock hound makes use of ultra-violet light in his searches. In the field the light is attached to a battery. I have visited a mine in Arizona where no important minerals could be observed. But when we put on the light, Sheelite almost jumped at us because of its fluorescence. Millions of dollars worth of ore that would not otherwise have been found have been discovered by the use of ultra-violet light.

The rock hound must have some knowledge of chemistry. He knows that turquoise, a sacred stone to the Indian, is a basic phosphate of copper and aluminum. Opal is a silicate with high water content. This makes it hard to work with since the heat developed in its processing expands the water and cracks the opal. Some rocks are hard to polish. The right method and the right polishing compound must be used. You cannot work an agate as you do jade, for example. A piece of aluminum wire is used to mark agate for

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What is Mathematics?

• **By Aaron Bakst, Ph.D.,** *(Columbia University)*
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This thoughtful article pleads for a broader understanding on the part of teachers and students of the whole subject of mathematics. It asks for a heart-to-heart talk between teacher and mature pupil, somewhat in the nature of a "sales talk."

Dr. Bakst outlines briefly some of the material he considers might well be included in such a discussion. His ideas should stimulate the thinking, and perhaps the self-examination, of teachers of mathematics.

Strange as it may seem, the question which is posed in the title of this paper is preferably avoided by the classroom teacher on the secondary school level. The pupil may be advised, asked (and on many occasions, compelled) to pursue mathematical studies. He may be "put through the paces" of presumably honest mathematical work. Rarely, if ever, he is challenged to stop and reflect. Rarely, if ever, he is encouraged to ask the most important question: What is this subject which I study?

Such a procedure conveys the impression that this question is taboo. All this seems to stem from the apparent reluctance of the teaching profession to approach this question without the fear of disturbing the hornet's nest of inquiry. Are the mathematics teachers filled with fear that the answer to this question may upset the mental equilibrium of mathematical studies? Are the mathematics teachers apprehensive that such queries might prove to be too difficult for the immature mind?

If the answer to the question What is Mathematics? is too difficult for the immature mind, then the teacher ought to stop and consider the subject of mathematics. Should we agree that the answer to this question is difficult (and thus, this question is to be judiciously avoided), then the subject of mathematics is no less difficult. But such is not the case, because the subject of mathematics is not difficult. It is difficult only if we make it so. It may be easy, if we set our minds to make it easy. And, by all rights, the pupil should be accorded the opportunity of knowing the nature of the subject which he studies. This same pupil is not denied the privilege of knowing the domain of historical inquiry. This same pupil knows what is the domain of geography, what is the concern of physics, of chemistry, of biology, and so on. But when mathematics is presented to the pupil, an aura of mystery reigns in the classroom. A knowledge of the nature of the subject is denied.

This paper does not pretend to be rigorous in the discussion of the nature of mathematics. On the contrary, its aim may be summarized as a heart to heart talk with the pupil. There is no harm in sitting down with the pupil, not in terms of a teacher and pupil relationship, but in terms of a friendly chat, and talking this subject over. If one wishes, we may call such a discourse, a "sales talk." Why not tell the pupil what he is expected to purchase? Why not be frank with the pupil and tell him what he can expect to gain from his studies, provided the "delivered product" is up to the specifications?

Mathematics is concerned with two types of fundamental elements, or, if we care to call them so, *fields*. One field is associated with the properties of **number**. The other field is concerned with the properties of **space**. True, the pure mathematician, of the more advanced type, will violently object to such a dichotomy. But this same mathematician forgets that one must climb the ladder of evolution, be it the case of biological growth or mathematical growth. Modern mathematics does not separate number from space. The two are now one, when they are studied in terms of the properties of sets and aggregates. But, when one takes the first (and not very steady) steps in mathematics, the division between number and space is very distinct.

Thus, the entire body of mathematics actually consists of two distinct fields, number and space. As the entire domain of mathematics is developed, these two apparently independent fields begin to display the characteristics of increasing dependence on one another. And this interdependence grows until the original separation loses its marked distinctness. This fact may be noted as early as in elementary algebra when the pupil is introduced to the coordinate methods, that is, to the arithmetization of geometry or the geometrization of number.

The development of the body of mathematics, that is, of the entire domain, stems from the two roots. The unification of the two distinct fields may be compared with the intertwining of the branches of the trees, except that these two trees are peculiar in their nature. The intertwining branches attach themselves to each other and, figuratively speaking, begin to lose their individual identities. Thus, as the development and evolution of mathematics progresses, it becomes evident that the original separation of number and space is, by and large, artificial in its nature. However, even this artificial dichotomy must be retained because it enables us to comprehend the genesis of the various branches of mathematics.

The concentration of the attention on **number** leads to the emergence of Arithmetic, then Algebra, and finally Analysis. On the other hand, the focusing of our interest on **space** leads to the development of Geometry. These major fields represent the fundamental divisions of mathematics. But, as indicated

above, none of these fields exists nowadays independently of the others. Such an independent existence would prove fatal to mathematics. The fertility of all these fields is a direct consequence of their mutual co-operative co-existence.

There is another phase of mathematics which divests itself of the concern about the content of the domain. It is concerned with the behavioristic characteristics of subjective phases of mathematics. We employ the term "behavioristic" advisedly because the mathematical investigations which are conducted in terms of these criteria concentrate the attention on the problem of "mathematical behavior." The two fundamental problems which arise under such conditions and circumstances are those of *variability* and *functionality*.

Variability represents the property of change. In other words, mathematical elements and their properties are investigated in terms of their changes. Variability involves the consideration of a mathematical element and the comparison of its properties in relation to its properties under some other conditions. This involves the consideration either in terms of spatial criteria or in terms of time, or both. Thus, variability is a spatio-temporal phenomenon. The criterion which is predominant in the formulation of the effected variation is associated with the notion of *measurability*. In other words, the effect of variability is measurable. However, it should be understood that the term measurable need not be confined in its scope to the notion of everyday measurement. We shall return to the problem of measurability presently.

The second phase, **functionality**, is a further extension of the criterion of variability. Functionality is the phenomenon which manifests itself when the variabilities of two (or more) mathematical elements indicate the presence of some relationship. The investigations of such relationships and of their characteristic properties represent the studies in terms of the criterion of functionality. Functionality may be detected if certain specific criteria are satisfied. These conform to the fundamental techniques which are employed in the processes of the determination of the presence of functional relations. Specific data concerning the mathematical elements must be secured. The individual data for every mathematical element must be arranged in some orderly fashion. The ordered data must be examined in order to ascertain whether variability is present. Finally, the ordered data must be matched so that some specific relation between the respective ordered data is discovered. Then, the final step takes place, that is, the relation is formulated. Fundamentally, this is a brief outline of the principles of functionality. Everything that takes place as a further extension of such investigations is a direct consequent of the initial fundamental steps. Furthermore, it should be understood that the studies of variability and functionality embrace the entire domain of mathematics.

Finally, there is a third phase of mathematics which may be called *procedural*. This phase is characterized by the criteria of *symbolism*, *measurability*, and *logical processes*. Once more, it may be pointed out, these criteria are applicable to the entire domain of mathematics. However, it should be understood that these criteria are not mere instruments which are employed in mathematics. Akin to some insatiable creature, mathematics not only employs these criteria, but it develops them into individual fields which represent more advanced fields.

Symbolism is associated with the processes of *abstraction*. Abstraction is a common every-day activity. Mathematical abstraction need not seem to be formidable if its techniques are understood. What may appear to us as a fearsome procedure is actually a process which is common to all humans. The fact that mathematics requires stages of abstraction which are peculiar in their colorings need not lead to a defeatist attitude. The imaginary difficulties of mathematics are associated with the fact that we are prone to "throw in the towel" when a minimum of concerted effort may carry us to the end of the fight. True, the sublimation of some mathematical fields (under the aegis of abstraction) may be represented by doctrines which seemingly have no direct appeal to the uninitiated. However, the average individual need not concern himself with the technicalities of those phases of mathematics in which symbolic manipulations may lift us to the dizziest heights. On the other hand, it is through abstraction that we finally achieve the unification of number and space into a single symbolic structure.

Measurability, when considered from the purely mathematical point of view, is broader in its scope than the problem of performing measurements. The criterion of measurability permeates the entire domain of mathematics. It is concerned with the properties of mathematical elements not only in terms of the measurements of magnitudes but its attention is directed toward the determination of the measurable chacteristics of the phenomena of variability and functionality. It is concerned with the properties of collections of mathematical elements while the statements of these properties do not require any specific numerical characterization. This represents an abstracted approach to the problem of measurement.

Logical processes are, perhaps, the best known and stressed procedures in mathematics as far as the pupil is concerned. But, the nature of these processes and the specific characteristics as far as the domain of mathematics is concerned are probably the least understood. The fact that logical processes are employed in mathematical activities is a predominant feature in the study of geometry. This same fact is completely ignored when other branches of mathematics are studied. Furthermore, the fundamental principles of the utilization of the logical processes as a *sine qua non* in mathematics are generally ignored. The fact that the development of mathematics is primarily deductive in nature is dutifully stressed. But the fact that a mathematical system which is deductive in form and structure is postulational in nature has certain implications which are completely ignored. These implications, however, are fundamental in and intrinsic to the nature of mathematics. The development of any mathematical system is based on a series of assumptions which are

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Feeding the U. S. Army

• By W. C. Hendricks

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The magnitude of the task of feeding the United States Army will be apparent to the readers of this outstanding article. During World War II the Quartermaster Corps had to supply food for as many as 24,000,000 meals a day.

Naturally, there are many problems of procurement, preparation, storage, supply and serving. The varied conditions under which the food is to be eaten have to be taken into account. Research is conducted continually to improve operational rations, their caloric and nutritional content, their variety and palatability.

The awareness of the Quartermaster Corps to its many and diversified problems is apparent throughout this article. Such vigilance explains how and why our men are the best fed soldiers in the world.

Before the attack on Pearl Harbor, the United States had never engaged in a major war which required the commitment of its Armed Forces beyond the Temperate Zone.

World War II saw our troops in action from the Arctic to the tropics. They fought on desert sands, in the teeming jungle, and over jagged mountain terrain. The global aspects of that war posed problems in feeding, clothing, and equipping a great Army which never before had confronted our military planners.

The challenge of this situation was met by the greatest mobilization of scientific research ever known in this country. Each military organization concerned with functions of supply speedily organized a research department if one was not already in existence. Those fortunate enough to have research programs under way proceeded to expand their fields and adapt them to the new situations. The aid of scientists, educators, industry, and business was invoked to lend every possible assistance in the momentous tasks imposed by the world-wide conflict.

KOREAN CONFLICT. Men receive their New Year's Day dinner, 1952, on the main line of resistence in the field. (*All photographs by U. S. Army.*)

Of all the problems involved in raising, equipping, and maintaining an Army that reached a peak of 8,000,000 men, none was more important than that of feeding such an Army. Food is the first and fundamental need of an Army, just as it is the basic requirement of civilian populations. It was realized that without a continuous supply of adequate food to subsist the troops, all military plans would be without avail.

The Army Quartermaster Corps, which is responsible for feeding, clothing, and supplying the Army with most of its individual equipment, found itself virtually without a food research program at the onset of World War II because of the lack of funds and personnel. This lack was but one reflection of the lowly estate to which the Armed Forces of the United States had been reduced after World War I—"the war to end all wars."

Mobilization for war brought about, among other things, the development of the Quartermaster Food and Container Institute for the Armed Forces. Situated in Chicago, at the heart of the Nation's food industry, this laboratory, under the direction of the Army's Quartermaster General, attacked the many and complex problems of devising rations necessary to feed

the Army at any place on the earth, at any season of the year and under any possible condition.

No person can appraise the part which United States Army World War II rations played in the outcome of that great struggle. At the maximum of effort, the Quartermaster Corps was supplying food at the rate of 24,000,000 meals a day. Except for troops which had access to organized messes, they subsisted upon what is known in Army parlance as operational rations, that is those made up of processed and packaged foods suitable for the subsistence of men separated from the kitchens of their commands. The veterans of 1941-45 well recall the operational rations by name—the C, D, and K, and 10-in-1.

These rations represented the best that could be designed and manufactured in the brief time available. They marked an important advance over anything theretofore known. The food was wholesome and nutritive. In contrast with the experience of previous wars, illness caused by defective foods was virtually unknown.

But these World War II operational rations were lacking in some respects. One of the shortcomings was that they lacked variety and palatability. This was especially true of the D ration, a concentrated bar made up of chocolate and cereal, which contained enough nutrients to sustain energy for a few hours in emergency conditions but which lacked acceptability—the men didn't like it and wouldn't eat much of it.

The K ration consisted of three waterproof packages—breakfast, dinner, and supper. It too had a good nutritive value, but it was never intended for use for more than three days at a time. When troops were required to maintain themselves on K rations for two or three weeks without a break, many experienced difficulty in consuming them. The D and K rations are no longer used. The C ration for individual combat, and the 10-in-one for small group feeding, were more satisfactory and are forerunners of the principal operational rations of today. Research and development have resulted in new-type operational rations which are so advanced over those available in World War II as to be hardly recognizable by the veterans of that war.

KOREAN CONFLICT. Infantrymen eat a hot meal before moving up to front lines. A jeep with a bullet hole in the windshield serves as the mess table.

Problems in Army Feeding

Feeding an Army and feeding the civilian population present the same basic problem, to provide the individual with proper nutrition. However, in the Army the problem is made much more difficult by circumstances which include the extent and variety of military operations; the scope of procurement (purchasing), storage, and distribution of supplies; varying food habits of men composing a mess; qualifications of personnel engaged in the preparation and service of foods, and many other factors, not the least of which are the time, place, and the conditions—military, geographic, and climatic—under which the food is prepared, served, and consumed.

The Army's Medical Department makes recommendations concerning food and feeding as they affect nutritional adequacy and the health of the troops.

The Army Quartermaster Corps purchases, stores, and distributes all items of food for the Army, Navy, Marine Corps, and Air Force. It conducts schools for the training of instructors who serve in the Army Food Service schools and prepares the courses of instruction, visual aids, and other material employed in such schools. It has inspection authority over Army food service activities and makes recommendations for improving food service schools and messes. In addition, the Quartermaster research and development program looks to the improvement of all types of foods and the development of improved containers and packages, as well as the equipment used in preparation, service, and preservation of foods.

The preparation, serving, and conservation of foods, however, is a responsibility of the Army commander, who appoints mess officers, mess stewards (formerly mess sergeants), cooks, bakers, and all others connected with food service in his organization. He is responsible for the kind of mess that is operated in his command.

Since World War II, the Army has directed critical attention to the subject of food. Orders from the Chief of Staff now require that food service must be improved continuously and to as great an extent as possible. To this end, food service is being made an attractive career for qualified persons. Qualifications have been made more exacting, grades and pay raised, and men who have the aptitude, interest, intelligence, and ability to excel in this type of work are being selected for food service positions. Constant rotation of troops, however, adds difficulty to this task.

Army Rations

The amount of food authorized for one soldier for one day is what the Army calls a ration. There are various types of rations,

each one determined by the conditions under which it is to be used.

Field A ration is the basic ration served to troops at posts, camps, or stations which have kitchens and refrigeration available. It consists chiefly of fresh meats, vegetables, fruits, and dairy products and is served to all troops whenever and wherever possible. It is served cafeteria style and is similar in content to home and restaurant meals. In order to maintain this ration, it is obvious that facilities for supplying and storing fresh foods must be available.

KOREAN CONFLICT. Cases of operational rations just unloaded from the S. S. "Sea Splendor" on pier at Pusan, Korea.

Operational ration B is prepared in organized kitchens which do not have refrigeration. It consists of non-perishable canned and otherwise processed foods and is set up on beachheads and behind the front lines as soon as a mess can be organized but before fresh foods can be received and handled. As refrigeration and fresh foods are made available, this ration is supplemented with fresh products and approaches the level of the A ration.

When troops are on missions which separate them from the kitchens of their commands they must depend upon packaged rations. These are the operational rations. They fall into two classes: those for small detachment feeding and those for individual combat feeding.

The 5-in-one ration is used for small detachment feeding. Its components are sufficient to feed five men for one day.

The C ration for the individual combat soldier, represents many improvements over the C ration of World War II.

Both the 5-in-one and the C rations are designed so that they may be supplied to troops as long as the situation may require. They are delivered by vehicle, air-drop, animal-carry, or man-carry. They may be eaten cold or they may be heated on small stoves or by heat tablets.

Assault packets are carried by the soldier on his person for initial stages of combat, and upon which he may rely for brief periods while it is impossible to supply him. Other types of rations include In-Flight rations for use by the Air Force or Army troops in aircraft, Survival rations, Supplemental rations, and a few other kinds.

Army Regulations provide that the minimum nutrient intake per day for each soldier subsisting on the A ration in areas of temperate climate shall consist of 3,600 calories and the following nutrient elements: protein, 100 grams; calcium, 700 milligrams; Vitamin A, 5,000 International Units; riboflavin, 2.2 milligrams; niacin, 16 milligrams; and Vitamin C, 50 milligrams.

These standards apply to troops under average conditions of physical activity. Because of plate and kitchen waste, a serving of at least 3,800 calories is necessary to assure that the minimum standards of nutrient intake are met. Depending on the type and degree of energy expended, some troops may require dietaries of higher or lower caloric level. Likewise, troops of the "teen-age" group require a higher nutrient intake for growth in addition to normal energy expenditure.

The required caloric intake under average conditions of physical activity is inversely proportional to climatic temperature. Thus, when prevailing temperatures in Arctic areas are below zero, the Arctic ration is appropriately adjusted to provide not less than 4,400 calories per man per day.

A general policy in reference to the Army mess is that a man may take all the food he wishes but he is expected to avoid waste.

The Master Menu

The Master Menu, used as a guide for the preparation of Field ration A, is compiled monthly in the Office of The Quartermaster General, Washington, D. C., and is distributed six months in advance of the dates for which the menus are planned, to every Army mess in the United States. Similar Master Menu guides are prepared and distributed in overseas commands.

Each menu is so planned that it will give a nutritionally adequate ration to the soldier. Because of local conditions and the possible unavailability of certain foods, substitutions are authorized.

Care is exercised in planning the Master Menu to make it conform in cost to the ration allowance prescribed by the Department of the Army and to insure that it contains all the nutrient elements required to maintain the soldier in full health and vigor, and that it provides sufficient variety to appeal to the appetites of the men. The Master Menu also contains recipes for the cooks to follow.

Illustrative of the Amy menu is the following, taken at random, for November 3, 1952:

BREAKFAST	DINNER	SUPPER
Oranges	Swiss steak with brown gravy	Beef with noodle soup with crackers
Ready-to-eat cereal	Baked potatoes	Ham slices with escalloped potatoes
Fresh milk	Lyonnaise carrots	Buttered peas
Hot cakes with hot syrup	Cole slaw with dressing	Tossed greens with lamaze dressing
Bacon	Whole wheat bread	Bread
Toast	Butter or Oleomargarine	Butter or Oleomargarine
Butter or Oleomargarine	Pineapple upside-down cake	Chilled sweet cherries
Jelly	Coffee	Coffee
Coffee		

The task of choosing food items for the Master Menu and methods of preparation presents serious problems. Certain items that are relished by some soldiers may not appeal to others. Surveys have been made during recent months to determine which foods are least, and which are most, generally acceptable. The studies covered meal patterns, food peculiarities, and the differences of individual preference due to age, sections of origin, family incomes, and other factors. As a result of these studies, changes in dishes to be served may be incorporated in the menus, and the present wide variety of foods may be reduced to conform with the choices which the soldiers order from the serving tables.

Food Service School for Army and Air Force, Fort Meade, Maryland. The student body eats the meals they have prepared. Here a Technical Sergeant instructor demonstrates techniques for sharpening the "tools of the trade."

Operational Rations and Food Research

Operational rations, upon which troops must depend who are engaged in combat or other missions which separate them from the kitchens of their units, do not include any fresh or perishable components. Yet they must contain the attractive and appetizing elements necessary for proper nutrition. At the same time they must have satisfactory stability, that is, they must maintain their purity, texture, taste, and appearance during many months of storage often under adverse climatic conditions.

Since World War II, as a result of the research and development program carried out by the Quartermaster Corps with the aid and cooperation of universities, industrial food laboratories, foundations, and various Governmental agencies, the Army has learned much about operational rations and has made many important improvements in them.

Quartermaster Food and Container Institute, Chicago. Test baking and scoring of bread for the purpose of improving the active dry yeast specification.

In connection with the food research program it has been learned that environmental factors have an important bearing on a soldier's attitude toward food. These environmental factors include climate, topography, and conditions of assault, support, and survival. The sights, din, and odors of battle are likely to affect the soldier's willingness to eat certain kinds of food and his inability to eat others. So also are the stresses of anxiety, fear, monotony, and fatigue.

Results of the research program are being realized in greatly improved methods of dehydrating various foods; in canned meats which are increasingly nutritious; and in pre-cooked foods which will permit the housewife to prepare a complete meal in less than a half-hour. These are only a few of the improvements already achieved. Many more are under way which not only will contribute to further advancing food service in the Army but which when available to civilians will greatly relieve the drudgery of food preparation in the home. As research on meat items progresses hand-in-hand with industry's ability to produce, the number and variety of processed meat items capable of being served to troops can be increased almost indefinitely.

As a result of field testing since World War II and battle testing in Korea, the accessory items in the new 5-in-one and the new C rations have been adjusted in accordance with indicated needs. The number of meat items, fruit components, and canned vegetables has been increased. The improved C Ration, containing 3,870 calories, intended only for brief periods of feeding, has been found to be sufficient for maintaining troops for a few days up to an extreme

(Continued on Page 146)

Patents and American Progress

• By William R. Ballard

CONSULTANT TO THE COMMITTEE ON PATENTS OF THE NATIONAL ASSOCIATION OF MANUFACTURERS, NEW YORK CITY

How has the American patent system affected the development of the country? How does it compare with similar laws of other countries? Is ours in the public interest? Does it take something from the public to give to an individual, who may then refuse to make his invention available to the public?

These questions and many others are answered in this informative paper written by an eminent authority. Mr. Ballard has had forty years' experience in patent law, much of it in the patent department of the American Telephone and Telegraph Company. He is the author of numerous articles and a book "There is No Mystery About Patents" (J. M. Barrett, New York) published in 1946.

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How shall we account for the amazing industrial progress and material prosperity in this country?

For untold centuries men struggled for only a bare existence—and many died early in their struggle. How is it that here in a few decades we have managed to change a wilderness into a land of comforts and comparative leisure? Why, with only some six per cent of the world's population and territory, have we three quarters of the world's automobiles, over half of its radios, over half of its telephones, etc.? Why does one hour's work in this country buy, in goods, as much as two or more hours' work in Britain or in Switzerland or Sweden, or as much as ten or more hours' work in Russia?

It can hardly be laid to a superior intelligence. Our people who have come from all over the world are very much like those in other countries. We are by nature no more ingenious and no fonder of exerting ourselves than our brethren elsewhere.

Our great store of natural resources is an important factor, of course, but other countries had, and still have, greater stores of many of the essentials of modern industry than ours, and we were a late starter in the field.

Ability and materials alone are not enough. There must be *incentive*: and that we have had in this country as no other country has had it. Some one has said that the human donkey must have either a carrot in front or a stick behind to move him. A stick behind may induce movement (backward, perhaps, as well as forward) but it cannot produce the enthusiastic combination of mental and physical activity necessary to create the miracle of America. Only the carrot will do that. And no carrot will induce persistent and self-sacrificing toil like the right of a man to keep and control the fruits of his own effort.

The unusual freedom enjoyed by our forefathers and their respect for private property were themselves a strong incentive to effort, and are today (to the extent that we are still free to do what we will and keep the reward for our work), but this incentive does not extend to the changes that we call industrial progress.

Devising new and better things and new ways of making things better, cheaper, or faster, is the hardest kind of work, it is usually expensive work, and it is always highly speculative. Without it there can be no industrial progress. Only a patent system can provide an adequate incentive to such effort, for it alone enables a man to retain control (for a time) of the new idea he produces.

Our patent system differs from that of the other major countries in offering a better price for the efforts of inventors than that offered elsewhere, and judging by results, we have hit upon about the right price.

Our patent laws give the inventor undisputed control over his invention for a period of 17 years— in the words of the Constitution "the exclusive right" i.e. the right to exclude all others for that time from practicing the invention. Nor is he required to use the invention himself, any more than he is required to use his own house. Thus, our laws are designed to make sure that the invention is not used during the patent term except by the patentee or upon conditions set by him. By contrast, the laws of other countries are designed to make sure, so far as possible, that *someone will* use the invention during the patent term; if not the inventor, then someone else, and on conditions which may be set by the Government.

Broadly stated, that is the difference, and it is the secret of our success.

To be more specific, other countries have compulsory licensing laws requiring the patentee to license others (on terms set by government if necessary), or which require the patentee to practice the invention in the country granting the patent on penalty of forfeiture of the patent or the licensing of others if he fails to do so; and practically all other countries impose heavy annual fees, often progressive, which must be paid merely to keep the patent alive. In several important countries there is no examination made as to novelty so that the patent amounts to nothing more than a *registered* claim to have invented something new. It takes no great insight to see how seriously such provisions of law reduce the lure of the patent to a would-be inventor.

The *sine qua non* for a successful patent system is that the reward held out shall be sufficient to induce the activity desired. Once we fix it so that no inventor can make a big financial success out of his patent, we may as well repeal the patent laws entirely.

Turning to patents as we issue them in this country, we find not only that they amount to a real incentive to inventors but that they are an incentive with rather magical properties. In the first place, every inventor tends to over-value his own invention. It is his own brainchild and it is wonderful, at least to him. Every inventor feels that he "has the world in a sling." So the prospect of an absolute control of his own invention for 17 years looks like a big thing to him and lures him on.

In the next place a patent, as nearly as is humanly possible, fits the amount of the reward to the actual value to the public of the invention upon which the patent is granted. If the invention is of great value to the public, the patentee can reap a great reward, while if the invention is of only small value to the public, he will be able to reap only a small reward. It would be utterly impossible to set a monetary reward at the time of the disclosure of an invention which would fairly represent the value of the invention to the public, or which would constitute as effective a lure to the inventor.

Again, a United States patent, with the complete control it gives of the invention, constitutes an incentive not only to the inventor but an incentive as well to the enterpriser who is to get the thing on the market and so make it available to the public. For him, it is indeed more than an incentive; it is well nigh a necessity. The production and marketing of new things quite generally involves considerable expense for experimenting, designing, tooling-up, sales promotion, etc.,—and always the risk of failure. If the enterpriser is not protected by a patent, he may stand this expense and take the risk only to have a competitor copy his results if the thing proves a success, and so, having no preliminary expense and no risk, the competitor can easily undersell him in the market. It has often happened that a new thing of promise has failed to reach the market because there was no patent to protect the man who made the initial outlay necessary for introducing it.

This strikingly underlines the value of the full-control character of our patents as contrasted with the compulsory licensing arrangements in other countries which introduce a prohibitive element of uncertainty into such a situation. Alexander Graham Bell wrote, as to compulsory licensing:

> ". . . it is almost too obvious for comment that the existence of such a law would make it practically impossible for the inventor to obtain capital. I cannot think of anything more effectively designed for the discouragement of inventive genius."

In recent years patents have been the object of attack by a small group. They have sought to destroy the patent system by amending the law to a point where the patent would cease to offer any real protection. They look upon a patent as a vicious monopoly carved out of the public domain and handed to an individual, as putting a hobble on business, as robbing people of jobs, and as preventing competition. What they have said and written shows that they understand little or nothing about patents or how they work. They have, from time to time, managed to get some very foolish bills introduced into Congress, but fortunately, Congress has refused to go along with them.

The truth is that a patent does not take something from the public to give to an individual, but, on the contrary, is *a means of getting something from an individual to give to the public* (when the patent expires). The truth is that patents alone *keep many small businesses going* as a host of small businessmen testified before a Congressional committee when one of the bills to emasculate the patent system was pending (see hearings on H.R. 9259 and H.R. 10068 in 1938). The truth is that patents *vastly increase* the number of jobs instead of reducing the number. And the truth is that patents *induce* competition, namely the competition in devising improved things and ways of doing things. If one man improves his product by a patented invention, his competitor is at once bound to do his utmost to find another improvement good enough to keep him in the running—and he usually does. He knows he must do it because there is no getting a compulsory license under the other fellow's patent. It is this constant struggle to keep up with each other that has put us, as a country, way ahead of other countries in technical advances.

Thomas Jefferson wrote: "the issue of patents for new discoveries has given a spring to invention beyond my conception."

Lincoln said: "the patent system added the fuel of interest to the fire of genius."

An editorial in *The New York Times* (May 8, 1938) said: "Yankee ingenuity became a byword the world over because of patent laws of unprecedented liberality. Thanks to them invention flourished."

In 1943, a commission of eminent men, including Charles F. Kettering, Owen D. Young, Chester C. Davis and Francis P. Gaines, appointed to make a thorough going study of our patent system, issued a report that gave its basic principles an enthusiastic endorsement. They said in part: 'The system has accomplished all that the framers of the Constitution intended . . . it has encouraged and rewarded inventiveness and creativeness, producing new products and processes which have placed the United States far ahead of other countries in the field of scientific and technological endeavor." And they concluded: "The Commission has reached the conclusion that the American system is the best in the world."

By any intelligent appraisal, we have something like a charm working here in America in the form of our patent system. Let us be vigilant that it be not destroyed. ●

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Titanium, Important Metal

• By W. B. Wylie, Jr.
TITANIUM METALS CORPORATION OF AMERICA, NEW YORK CITY

Titanium, the infant metal of industry, did not achieve commercial production until the past half dozen years. But many important uses for it have already been found.

Its superior strength-weight ratio, its ability to stand fairly high temperatures, and its corrosion resistance have made titanium of great interest to the aeronautical and chemical industries.

This up-to-the-minute article contains much information about the production, properties, and uses of this metal that may not be readily available to teachers.

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Titanium metal, the recipient of much publicity the past several years, is now beginning to justify some of the elaborate claims and predictions of the early enthusiasts. Not that titanium has reached full maturity by any means, but this new metal has progressed well along the road toward a potentially great and urgently needed industry.

Titanium is rightfully classed as a light metal, being 56 per cent as heavy as alloy steels. It derives its utility and prominence from superior strength-weight ratio and a corrosion resistance virtually uncontested by other structural metals.

Titanium is not a new metal, minute quantities having been produced as long ago as 1910. However, the metal so produced was not pure enough to demonstrate its desirable physical properties, and the production method was so complex that interest waned. With the release of the Bureau of Mines Information Circular No. 7381 in late 1946, new life was breathed into the lungs of the dormant titanium infant. This circular announced the operation of a pilot plant producing batch lots of high-purity titanium by the newly-developed Kroll Process, developed by a citizen of Luxemburg and consultant to the Bureau, William J. Kroll.

Actually this announcement was not too seriously received by the metals industry, and it was only through the persistence of the Bureau of Mines and a few far-sighted military men that recognition was given the newcomer. Within a few years several industrial interests had organized facilities for the commercial production and marketing of titanum.

Today, the principal method of production is basically the same as that of 1946, with certain modifications to permit greater efficiency and capacity. Fundamentally this process is one of chlorination of the titanium oxide (rutile-TiO_2 or ilmenite—$FeTiO_2$, or titanium-rich blast furnace slags) to produce liquid titanium tetrachloride. This, when reacted with magnesium metal in a heat-resistant steel vessel at red heat and under an inert gas blanket, produces titanium sponge and liquid magnesium chloride. The bulk of the magnesium chloride is then drained from the reaction chamber and the remnants evacuated as a vapor. Recovery of the magnesium and chlorine is accomplished by passing the magnesium chloride through an electrolytic cell. Thus these constituents may be recycled continuously.

The titanium sponge must be further processed to consolidate the porous masses into ingot form. Titanium Metals Corporation has preferred electric-arc melting in water-cooled copper crucibles with tungsten-tipped electrodes and under an inert atmosphere (argon or helium).

Under the direction of S. A. Herres, the melting procedures have been greatly modified during the past two years, thus allowing the ingots to grow from but a few pounds to a present size of about 1500 pounds. Slab ingots of 2000 pounds or more are proposed for the near future.

Consistent with this growth in ingot size is Titanium Metals Corporation's recently activated plant at Henderson, Nevada, where the modified Kroll-type reactor installations will have a designed capacity of 10 tons per day by mid-1953. Early in 1952, this plant was producing a ton and a half of sponge per day.

While there are, admittedly, many obstacles to overcome and vast realms of technology not yet explored, the industry-wide production figures verify the tremendous progress made in a relatively short space of time. By late fall of 1950 an annual rate of 60 tons was announced. The year 1951 saw some 700 tons produced; estimates of 5000 tons in 1952 are not unreasonable.

Even though these production figures are impressive, the current demands far exceed the capacity. The jet engine programs of the major aircraft engine manufacturers are consuming ever increasing quantities of titanium forgings. Also the airframe builders are beginning to use far more sheet and structural shapes in their designs, particularly advanced designs of supersonic craft which heat up significantly as the result of air friction.

The enthusiasm of the aeronautical industry for titanium is readily understood when the design problems are analyzed. There is an urgent need for maximum strength to withstand the tremendous stresses developed in modern ultra high-speed craft. At the same time the weight must be kept at a minimum. While aluminum (.10 lb/in^3) and magnesium (.063 lb/in^3) are lighter, they suffer certain strength and temperature limitations which restrict their adaptability to many applications for which titanium is being investigated. For example, while titanium is not literally a high temperature metal, it does retain sufficient strength up to operating temperatures of 800°F. to

label it as infinitely more desirable in such applications as fire-walls, engine nacelles, hot-air ducts, etc. Temperatures between 350° to 400°F. developed in flight, due to friction alone, approach the thermal limits of aluminum and magnesium, whereas titanium can safely be used.

By replacing stainless steel components with lighter titanium, and aluminum with thinner sections of appreciably stronger titanium alloys, the weight saving can conceivably amount to several tons in the larger planes. For military craft this is particularly critical, since the armament can be increased proportionately without increasing wing loading or sacrificing speed. In future designs incorporating titanium, radical construction methods may be developed to utilize the full strength-weight ratio of titanium to produce sleeker, stronger, and faster airfoils to further investigate the supersonic speeds about which there is so much speculation.

These qualities can also be advantageously incorporated in commercial airlines to permit increased pay load and/or range, along with less structural dead weight.

The chemical industry has shown considerable interest in titanium primarily for the corrosion resistant properties which in many cases permit the performance of various reactions in titanium systems which heretofore were restricted because of frequent replacement and excessive maintenance time. One chemical concern with process equipment involving sulphuric acid up to 22 per cent at high heat and pressure conducted service tests which demonstrated titanium to be virtually unaffected, whereas the most highly touted alloy steels were chewed up within a few hours. Another concern reported corrosion rates of 22,000 mg/cm^2 for Hastelloy and Illium G as against 4 mg/cm^2 for titanium.

The medical profession is actively investigating the use of titanium in prosthetics where preliminary tests have indicated excellent properties within the human body, resisting corrosive elements and causing no harmful reaction with body tissue. Here again where relatively light weight and high strength are imperative, the use of titanium is viewed with great favor as a step forward in this intricate and humane application.

The atomic research program employs moderate quantities of titanium where its use as a container vessel for liquid metals has been partially explored. It has exhibited excellent long-time resistance to gallium at 752°F., molten zinc at temperatures in excess of 900°F. and tin at 932°F. Short time service life was reported for mercury at 622°F. Lead severely attacks titanium at 1830°F.

The superlative resistance to salt water and to marine atmosphere attack has marked titanium as a highly desirable ornamental and structural metal for unlimited maritime applications.

At present, titanium is available in many forms: forgings, hot rolled round, square, rectangular and hexagonal bars, plate, sheet, strip and wire. Forgings may be made in open or closed dies with standard equipment, and in sizes ranging from a few ounces up to ingot limitations of about 1500 pounds. The selling price would range from $10.00 to $16.00—forging or bar price—per pound depending on size and quantity ordered. Hot rolled bars are available from 5/16" diameter up to 3" diameter and in commercial lengths of 12 to 14 feet. Here the price average would be about $14.00 per pound.

Wire may be obtained in sizes down to .005" in diameter. Current experimentation and development work may soon make available even finer gages. Small bar and wire prices range from about $19.95 per pound for .625" (not usually called wire) up to $52.60 per pound of .010" to .005" round wire. A pound of titanium would yield some 3.5 miles of .005" titanium wire.

Present plans call for the extrusion of tubing and special forms in the near future to add to the diversification and utility of titanium. Currently, limited quantities of Weldrawn titanium tubing are being produced on an experimental basis and the results have been very favorable.

An extensive investigation of the alloys of titanium is under way and it is the firm belief of the industry that elevated temperatures (up to 1000°F. at least) may soon be well within the service range of titanium.

The future of titanium is bright, and the exhaustive research and development programs now under way will undoubtedly penetrate the complex and formidable natural boundaries which so far have been only partially infiltrated.

Several road blocks are now hampering adoption of titanium in many applications for which it is well qualified. These are:

1. High cost.
2. Limited availability, discouraging acceptance in scheduled production assemblies.
3. Lack of uniformity between successive heats, now being overcome by production of large ingots and better quality control.

There appears to be little reason to doubt that titanium will continue to attract the attention of technical men in certain specialized industries, until such time as production technology can supply the metal in abundant quantities and at competitive costs, and thereby open up widespread applications throughout all industry. ●

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"Science, by contrast, is one of the great intellectual achievements of our Western culture. It has form, structure, depth, relevance to history, and complex interrelationships with the rest of modern thought. This, of course, is another important reason why science deserves an honored place in general education programs. And in my mind we fail of our purpose if this aspect of science is not impressed on our students."

—KONRAD B. KRAUSKOPF
The Journal of Higher Education.

Junior Naturalists

• By W. Drew Chick, Jr.
CHIEF, NATURALIST DIVISION, NATIONAL CAPITAL PARKS, WASHINGTON, D. C.

Here is a detailed account of what an alert group of six naturalists has accomplished in conducting a Junior Naturalist Training Course for 650 children.

Procedures are discussed, home study projects outlined, and field work described. Awards of merit are granted for varying degrees of participation.

The basic plan used in Washington can be modified for adoption elsewhere.

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In the Spring of 1952, six hundred and fifty children and six naturalists participated in the National Capital Parks 13th annual Junior Naturalist Training Course. The significance of these figures is readily apparent to anyone who has led field trips.

By announcement to the schools of the Washington, D. C., metropolitan area, children aged 9 to 12 years are invited to participate in the course sessions over a six-week period from late March through April. Over the years this activity has proved to be the most successful in our varied program for children of that age group, but the response in 1952 was almost overwhelming. We have no logical explanation for the fact that the participation doubled that of the highest previous year.

"A drawing from the movie is reproduced . . . . . ." and "the children are asked to color (it) as they remembered it from the film."—*Photograph by Chick, National Park Service.*

The children come on six consecutive Saturdays from 10 A.M. to 12 noon. The first and fourth Saturdays are spent indoors. They are devoted to illustrated talks, demonstrations, and films on the subject matter of the course. The same two hours on the other four Saturdays are spent on field trips conducted by the six members of the naturalist staff. In addition, there are two one-hour bird observation trips at 7:00 A. M. on Wednesdays. This schedule demands close cooperation between the child and his family, especially for those who wish to earn one of the three types of awards.

A certificate of completion with honor is awarded to those who have perfect attendance at scheduled activities and who submit a complete project book which shows extra work based on their own initiative. A certificate of completion may be awarded to those who miss only one of the Saturday morning meetings and only one of the bird observation walks, and who complete a satisfactory project book. Others who turn in a project book, but whose attendance does not meet the requirements for one of the certificates, may receive a letter of participation. These various awards are presented at "graduation exercises," and at that time the project books are returned.

Each project book contains ten work sheets, which are prepared by the naturalist staff before the start of the course each year. In addition to completing these work sheets, each child is expected to make five leaf prints and an animal observation report.

The work sheets are mimeographed and they contain sketches and various types of questioning techniques covering the subject matter of the indoor meetings and field trips. One deals specifically with the U. S. Forest Service film, "Life Blood of the Land," which depicts the interrelationships of soil, forests, fire, and erosion. A drawing from the movie is reproduced in the work sheet together with a written explanation. The children are asked to color the drawing as they remembered it from the film, and to complete a set of true and false statements based on the principles learned.

Another of the work sheets deals with the homes of birds. It consists of sketches of se-

"A certificate . . . is awarded to those . . . who submit a complete project book which shows extra work based on their own initiative," such as this cover design.—*Photograph by Sullivan, National Park Service.*

EACH CHILD makes five leaf prints as part of the requirements for an award. This one was made with a stamp pad.—*Photograph by Sullivan, National Park Service.*

lected nests in typical locations and written clues concerning the birds whose nests are depicted. In order to complete the work sheet, the children are given sets of bird picture cards furnished free by a commercial firm, and they are asked to match the birds with their nests.

Still another work sheet has to do with the places where certain spring wild flowers grow. Matching the leaves and fruits of trees is the subject of another. The form and shape of trees in winter time, the hydrologic cycle, stages in the lives of amphibians and reptiles, animals and their food, and the adaptation of birds' beaks are among the subjects covered in still other work sheets.

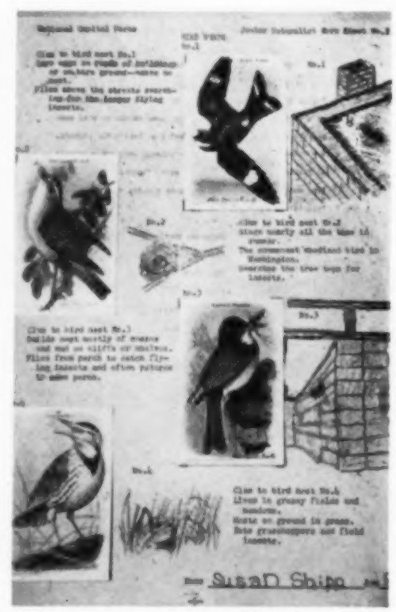
Besides these, two other exercises are included in the project book: leaf prints, and a report. Mimeographed instructions for making leaf prints are given to each child and several methods are demonstrated in an illustrated talk at one of the indoor meetings. For the animal observation report, the child is required to watch a wild animal and to record what he sees it doing. From 50 to 100 words of description are required, and the observation may be illustrated with original sketches, photographs, or in other appropriate ways. Suggestions for preparing this report are given in writing, in movies at the indoor meetings, and on field trips. Many of the youngsters show very keen powers of observation and insight through this exercise.

One may wonder how six naturalists can lead six hundred and fifty children effectively on field trips. It is not easy, but it can be done. The author described workable techniques in an article for the May, 1948 *Nature Magazine*. The children themselves are most cooperative. Many adult leaders of youth groups, whose memberships participate in a body, swell the total number present. These grownups, together with parents, are in addition to the children actually enrolled in the course.

Because of the large attendance this year, it was necessary to work out a new method of organizing the groups for the field trips. The naturalists arrived early at the meeting places. As the children came, each was assigned a partner and they were lined up, one pair behind the other. As soon as the first hundred children arrived, a naturalist was assigned and the group started on its conducted trip. Places in the park system where the trips were conducted were selected so that many groups could be dispersed over different routes without interfering with one another. Thus it was possible to organize the groups quickly, to start them out with a minimum of confusion, and to have all six parties operating in the same area with little or no contact with one another during the course of the morning.

While it is true that many of the more than six hundred children participating attended only one of the eight meetings, it is notable that 338 children received one of the three awards. Of that number there were 42 letters of participation issued, 142 certificates of completion, and 154 certificates of completion with honor. When it is realized that the fourteen hours of instruction in the scheduled meetings was matched or exceeded by the children in preparing and completing their project books, the certificate represents a very tangible effort.

The course follows the same basic pattern each year, but the work sheets differ and a soil conservation or other exercise may be substituted for the animal observation report. Copies of the course outline describing the requirements for the various awards and a schedule of meetings, and of the ten work sheets are available to anyone interested in trying a similar program.



"ANOTHER of the work sheets deals with the homes of birds."—*Photograph by Sullivan, National Park Service.*

It is our objective in the annual Junior Naturalist Training Course to teach the children the proper use of their park system. In so doing, we have demonstrated effective reduction of vandalism and a greater appreciation of park values. The children who participate have an enriched science experience, they learn more about their city, and what is perhaps of most significance, the whole family benefits. ●

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"Learning succeeds to the degree that the learner feels that what he is learning matters to him and to the degree that he is actively engaged in the process. Neither factor is effective without the other; learning is their product, not their sum." —HERBERT SCHUELER

Surface-Active Agents and Their Newer Applications

• By Martin Blake, Ph.D., *(Ohio State University)*
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Is ordinary soap on its way out?

It is being replaced in numerous cases by new synthetic detergents which have special advantages for particular uses.

This paper, the first of two on the same subject, discusses the Anionic cleansers. Here you may learn about Teel, Dreft, Drene, and other products whose names are familiar.

The second paper will deal with Cationic and Non-Ionic agents.

PART I

Introduction

A surface-active agent is a soluble material that reduces markedly the surface tension of a solution, or the interfacial tension between two immiscible phases, such as oil and water. The phenomenon is referred to as surface activity. Depending upon the particular uses made of these agents, they are called wetting agents, detergents, spreading agents, anti-foaming agents, emulsifiers, and even bactericidal agents. A single compound may perform two or more functions at the same time. Today, a particular agent can be designed for a specific purpose.

The oldest and still most popular surface-active agent is ordinary soap. Within the last few decades, however, the large number of synthetic agents flooding the market has threatened the continued popularity of soap.

As a rule, surface-active agents are composed of a hydrophilic (water-liking) or lipophobic (fat disliking) portion, and a hydrophobic or lipophilic portion. The hydrophilic part may contain a carboxyl, sulfate, sulfonate, alkali, alcohol, ether, or a halogen group. The hydrophobic part is usually either a long hydrocarbon chain, such as is found in fatty acids, or a cyclic hydrocarbon. The hydrophobic portion is non-polar in nature, the hydrophilic portion polar. Neither the hydrophilic nor the lipophilic properties may be strongly dominant. In emulsification this is particularly important. When there is a proper balance, the polar portion of the molecule will be attracted to the aqueous phase, and the non-polar portion to the non-aqueous phase. The surface-active agent concentrates at the interface and exerts its surface-active properties in the form of dispersion, wetting, detergency, emulsification, etc. When the hydrophilic properties are strongly dominant, there is a tendency for the surface-active agent to be drawn entirely into the aqueous layer. This prevents it from exibiting surface activity.

A completely satisfactory classification of the innumerable surface-active agents is difficult to arrange. They may, however, be divided into three main classes based on the structural make-up of the molecule. Group I is composed of the anionic agents. Their activity is due to the anion, which is the lipophilic group. Group II contains the cationic agents. The activity of these compounds is due to the cationic portion of the molecule, which in this case is the lipophile. Group III contains the agents which are non-ionic in nature. These contain both polar or hydrophilic, and non-polar or lipophilic groups. The molecule does not dissociate into ions as it does in the first two groups.

All the recently marketed agents will find a place in one of these categories. Space does not permit a detailed survey of the whole field. We shall attempt only to acquaint the reader with the more popular agents now available on the market.

Anionic Agents

Anionic surface-active agents are the most widely used. They include the ordinary household soaps, which are mixtures of the alkali salts of fatty acids which range in carbon length from 12 to 20. The sodium salts of palmitic and stearic acids form the greater part of common soaps. It is interesting to note that the fatty acids, per se, are not surface-active agents. The lipophilic nature of the molecule is too dominant. Replacing the carboxyl hydrogen with a monovalent alkali increases the hydrophilic nature of the molecule and confers surface-active properties. Stearic acid is a poor agent, whereas sodium stearate is effective. The chief disadvantage of anionic agents is that they are not suited for use in hard water. Insoluble soaps, which are chemical salts, are formed with the metallic ions present in the water.

Stimulated by the acute fat shortage during World War I, Germany produced the first soap substitutes. These are the alkyl naphthalene sulfonates. They are marketed as a dry powder containing about 90 per cent active ingredient. They are good for dishwashing and household scouring powders and are used for the washing of glass, porcelain, and floors. Propyl naphthalene sulfonate is marketed as Alkanol B (Du Pont), Aerosol O.S. (American Cyanamid Corp.), and Naccosol A (Allied Chemical and Dye Corp.).

Higher alkylated aromatic sulfonates are also used as synthetic detergents. The hydrocarbons from kerosene furnish a cheap starting material, and the chlorinated product obtained from them is called keryl chloride. This is condensed with benzene, and the product is sulfonated, then neutralized, and purified. Nac-

conol NR (Allied Chemical and Dye Corp.), Santomerse No. 1 (Monosanto Chemical Co.), and Santomerse D (Monosanto Chemical Co.) are representatives of this group. Homologues of benzene, such as toluene, xylene, and cumene, are also employed as the aromatic nucleus. Ultrawet E (Atlantic Refining Co.) and Aronite Detergent (Aronite Chemical Co.) are representative.

The sulfate esters form another important group of soap substitutes. These often are, but should not be, referred to as sulfonated products. They are true sulfate esters since the sulfur atom is connected to a carbon through oxygen. They are readily hydrolyzed.

The term "sulfonation" is often loosely applied to indicate a reaction with sulfuric acid without regard to the nature of the final products. The sulfated oils are representative of this class. Oils rich in oleic, ricinoleic, or other unsaturated fatty acids containing one double bond are the most desirable starting material. Highly unsaturated and more completely saturated oils are not suitable. The sulfuric acid molecule adds across the double bond and also condenses with the free hydroxyl groups. The sulfate radical introduces a strongly hydrophilic group into a molecule which is dominantly lipophilic. The result is a wetting agent of a well-balanced hydrophilic and lipophilic nature. The sulfated oils find extensive use as detergents, shampoos, hand cleansers, etc. These are not trade-named, nor are they protected by patent rights. Their chief advantage is that they are cheap. The propyl, butyl, and amyl esters of oleic acid or ricinoleic acid may be sulfated. The resulting products are marketed under the trade names of Parapon (Arkansas Co.), Phi-O-Sol (Onyx Oil and Chemical Co.), and Surfax W.O. (E. F. Houghton and Co.).

The sodium salts of the acid sulfate esters of normal, primary, aliphatic alcohols are widely employed particularly as a household cleansing agent for dishes, clothes, etc. They are used whenever a good detergent, wetting, or emulsifying agent is desired. They are marketed as individual materials or as the active ingredient in commercial products in strengths from 25 to 90 per cent.

The alcohols obtained from the hydrolysis and reduction of coconut oil make a satisfactory starting material. By this process lauryl alcohol is formed in the greatest amount (about 40 per cent). Alcohols containing chains of 8 to 20 carbons are present. The mixture is esterified with sulfuric acid and neutralized with sodium hydroxide. Such agents are compatible with hard water since the metallic soaps are soluble in water. These are marketed under such names as Gardinol LS (Proctor and Gamble), Duponol (Du Pont Co.), Modinal (Proctor and Gamble), Orvus (Proctor and Gamble), Maprofix (Onyx Oil and Chemical Company), Sandopan (Sandoz), and Dreft, Irium, Drene, and Teel (consumer items). Sodium lauryl sulfate is found in *The United States Pharmacopeia* where it is defined as, "a mixture of sodium alkyl sulfates consisting chiefly of sodium lauryl sulfate."

Synthetic alcohols are sulfated to form excellent wetting agents. Tergitol 08 (Carbide and Carbon Chemical Corp.) is the sulfate of 2-ethylhexanol. It is marketed as an aqueous solution containing 25% active ingredient in the form of the sodium salt. Other Tergitols use different synthetic alcohols as the basic starting material.

Vel, a household commodity, marketed by the Colgate-Palmolive Peet Co., and also known under the names of Arctic Syntex N and Arctic Syntex L, is the sulfated monoglyceride of the fatty acids found in coconut oil.

$$RCOOCH_2\text{-}CHOH\text{-}CH_2\text{-}OSO_3Na$$

An Alkyl Sulfate Surface-Active Agent

In the above structure the *RCOO-* group is mainly lauric.

As a rule alkyl sulfates are expensive because of the high cost of obtaining the fatty alcohols. It is much less expensive to esterfy the fatty acids directly with one hydroxyl group of a low molecular weight glycol, or with glycerol. Another hydroxyl remains free to be sulfated. The resulting compounds are unstable in the presence of hot acids or alkalies. They are sufficiently stable for general household cleaning and washing, as well as for many industrial uses requiring a surface-active agent.

Alkane sulfonates are a popular group of surface-active agents. These compounds are not subject to hydrolysis since they are not true esters. The sulfur atom is attached directly to the carbon. The bond between the two is stable. When the alkanes are obtained from the fractionation of petroleum, the sulfonated products are called "petroleum sulfonates." Commercial examples of alkanesulfonates are MP-189 (Du Pont Co.) and Nytron (Solvay Process Co.)

The esters of alkane dicarboxyl sulfonates are another class of surface-active agents of the anionic type. The sulfosuccinates are made indirectly by esterifying maleic acid. Sodium bisulfite is then added across the double bond to form,

$$\begin{array}{r} H\phantom{\text{-COOR}} \\ HC\text{-COOR} \\ |\phantom{\text{-COOR}} \\ NaO_3S\text{-}C\text{-COOR} \\ H\phantom{\text{-COOR}} \end{array}$$

The product can be found in *The National Formulary* under the title dioctyl sodium sulfosuccinate. It is known commercially as Aerosol OT (American Cyanamid Co.). It is stable to acid and to mild alkaline solutions, and exhibits good surface activity. It is used mainly as a cleansing agent and in the preparation of ointment bases. Aerosol OT is the dioctyl ester. Aerosol AY is the diamyl ester and Aerosol MA is the dihexyl ester. These are all marketed by the American Cyanamid Co.

It is sometimes desirable to replace the strong basic cation of soaps with a milder organic base, or even with ammonia. Such compounds are referred to as "amine soaps." Mono-, di-, and triethanolamine, mor-

(Continued on Page 145)

About Precious Stones

• By Dagmar H. Beissinger, *Gemologist*
IMPORTER OF PRECIOUS STONES, PITTSBURGH, PENNSYLVANIA

This interesting paper was written by a professional gemologist. Dagmar Beissinger studied at the Universities of Berlin and Vienna, and has had wide experience in testing, classifying and evaluating gems.

Mrs. Beissinger visits Europe regularly to select precious and semi-precious stones. Most of them are cut in Germany because of the skill and long experience of the workers and the comparative cheapness of German labor.

This is the first of a series dealing with unusual occupations that THE SCIENCE COUNSELOR *plans to publish at irregular intervals.*

Precious stones have always had a great fascination for all people throughout the world. To early civilizations the possession of gem stones meant good fortune, health, prosperity and protection from evil. To modern men, ownership of gems has little to do with such old beliefs. Their gems reflect more an expression of their culture, taste, and a certain financial independence.

But the desire for precious stones has remained unchanged through centuries. Only the finesse has changed with which men extract the utmost beauty from gems through skillful cutting. Superstitions have to a great extent been replaced by accurate knowledge, (which is the science of Gemology). The human tendency towards mysticism and use of symbols, however, is responsible for the still popular custom of having birthstones, which is said to have originated in Poland some 400 years ago.

The story of most gem minerals began millions of years ago. Many of these minerals came into being as a result of great pressure exerted during movements of the earth's crust. Others resulted from the cooling and crystallization of molten material, usually deep within the earth. Gems have also been produced from the deposition of solid material from water circulating through fissures and open spaces in the rocks of the earth's crust.

Before precious stones are found by men, it is possible that they may have travelled thousands of miles from their original point. They are now mined in nearly every part of the world.

The world's finest rubies and sapphires, for instance, are found in the Mogok area in Burma, which is also the major source of jade. A fine ruby is the most expensive stone. Actually, a ruby is a red sapphire. Sapphires of most desirable color, however, are found in the Kasmir area of India. Ceylon doubtless produces a greater variety of precious stones than any other area of similar size in the world. Persia is famous for its superb turquois, while Afghanistan prides itself for lapis lazuli of unmatched color. Colombia, South America, produces choice emeralds. A fine emerald is more rare and more valuable than a fine diamond of the same size. Brazil is a number one source for a great many precious stones, such as amethyst, topaz, aquamarine, beryl and tourmaline.

Europe has no important gem deposits, except amber, found in plentiful supply on the shores of the Baltic Sea, garnet in Bohemia and jet in Whitby, England. White and black opals of brilliant color come from Queensland, Australia.

In the United States, the western regions produce turquoise and agates, while numerous varieties of quartz are found throughout the country. Nephrite is mined principally in Wyoming. Sapphire is a Montana product. In North and South Carolina tourmaline and beryl exist in varying quantities.

Every precious stone has different physical and optical properties or charactersitics. Hardness is an important physical property which depends upon the internal structure of the stone. It may be defined as the resistance to being scratched. Its degree also affects the beauty of a stone because the ability of a gem to receive and retain a high polish varies to some extent with the degree of hardness.

Optical properties include color, transparency, dispersion and luster. Transparency or translucency very often influence the beauty of a stone. However, the value of a gem stone depends almost entirely on these three components: Beauty, Rarity, Fashion.

A rare, beautiful specimen might not always produce a beautiful gem stone. So much depends on the proper fashioning of a stone that a skillful lapidary can greatly improve a stone of inferior material. But the inexperienced cutter might spoil through poor cutting what might have been a gem of exceptional value.

Oriental stone cutters still operate with primitive methods. In spite of their custom of sacrificing beauty for some added caratweight, these lapidaries cut lovely, fiery stones with rather awkward-looking, unsymmetrical angles and facets. These stones would lose most of their beauty and fire if recut to correct symmetrical proportions by either European or American cutters. For this reason, Oriental cutting is still considered inferior and detracts from the value of a gem. European and American lapidaries have achieved perfection in their masterful art. Their experience and genius combine to obtain the greatest measure of beauty and value from the uncut gem with the minimum waste and loss of weight.

Rarity eminently affects the value of a stone. It is an attribute which has always been cherished by men.

(Continued on Page 142)

NEW BOOKS

Free and Inexpensive Learning Materials

- *By* DIVISION OF SURVEYS AND FIELD SERVICES. Nashville, Tennessee: George Peabody College for Teachers. 1952. Pp. VIII + 194. $1.00.

The four earlier editions of this valuable teaching aid have clearly demonstrated its value. They have been reviewed favorably in this journal. We have little new to say about the fifth in the series. Every teacher who wants to enliven his science course by the use of the kind of exhibits and publications described in this study should consider this new paper-bound edition a "must."

Teachers who work under limited budgets will find it especially helpful. Most items are free. With few exceptions, no item is listed that costs more than fifty cents. Nearly two-fifths of its 2500 entries are new. They are cataloged under 270 headings.

H. C. M.

DDT and Newer Persistent Insecticides

- *By* T. F. WEST and G. A. CAMPBELL. New York: Chemical Publishing Co. 1952. Pp. XIV + 632. $8.50.

The Author Index alone of this valuable book occupies fifteen double column pages set in small type. It is evident that much work has been done on DDT, and that the authors have searched world literature diligently in their compilation of published studies concerning this important insecticide. Its value in destroying plant pests and human and animal parasites was discovered in Switzerland in 1940. Introduced into Great Britain and the United States late in 1942, it was largely responsible for the Allies' control of typhus during World War II through the destruction of the body louse. Undoubtedly it saved thousands of lives.

Here is an account of the chemistry of DDT and how it is used in paints, textiles, paper, etc. and its success when used against mosquitoes, household insects and plant parasites. Consideration is given to its effect on beneficial insects and to its toxicity to warm-blooded animals and to humans. A section of the book is devoted to the study of other chlorinated insecticides including benzene hexachloride, chlordane, toxaphene and others.

Chemists, microbiologists, horticultural and agricultural workers and others will welcome this noteworthy compilation.

H. C. M.

From Atomos to Atom: The History of the Concept *Atom*.

- *By* ANDREW G. VAN MELSEN. Translated by HENRY J. KOREN, C.S.Sp., S.T.D. Pittsburgh: Duquesne University Press. 1952. Pp. XII + 240. $4.25.

Scientist and philosopher alike should welcome this historical study of the concept *atom* by Doctor A. G. M. Van Melsen, professor of the Philosophy of Nature in the Charlemagne University of Nijmegen, The Netherlands. To the scientist it offers the opportunity to examine the classical scientific theories that have contributed to the advance of modern science. To the philosopher, and to others equally uninitiated in science, it offers a comprehensive history of the concept *atom* from the age of Greek philosophy to present day scientific atomism.

The first part of the book is an analysis of the concept *atom* before the rise of modern physical science. It begins with the Greek thinkers of the sixth century B.C., and ends at the beginning of the nineteenth century. The second part of the book is an analysis of nineteenth and twentieth century atomism, concluding with a discussion of the relation of philosophy and science.

The thinker most responsible for Greek atomism, Democritus, (born circa 460 B.C.) proposed immutable, small particles (atoms) in order to show that change in the structure of matter was merely a change in the arrangement of the particles of matter. His proposal was not a scientific one, yet it did contain some scientific truth. He had no positive proof that matter was composed of small particles. As Professor Van Melsen points out: ". . . his (Democritus') theory is a philosophic system, although it contains the germ of a physical theory. As a physical theory, however, Democritus' atomism is still too vague."

The Middle Ages, through the influence of Aristotle, rejected the philosophical atomism of Democritus. Thanks to Professor Van Melsen, we now know that the Aristotelian doctrine of *minima* (i.e. smallest particles) was the medieval counterpart of the Greek notion of the *atom*. The Arabian Aristotelians of the late Middle Ages were especially acute in their development of the minima theory.

During the Renaissance, interest in the atomism of Democritus was revived. This revival of atomism, coupled with the medieval doctrine of *minima*, forms the philosophical background of the modern physical notion of the *atom*.

From Atomos To Atom provides us with new insights into the origins of modern science. Instead of condemning medieval Aristotelianism for surpressing Democritus all too long, history now must credit the

Aristotelian tradition with aiding in the rise of modern science.

The book's first section ends with a discussion of the thinkers of the seventeenth century. This is the period of transition from a philosophical notion of the atom to a scientific notion, when men like Robert Boyle developed the first chemical and physical theories of modern science.

The second half of the book is devoted largely to the rise and development of modern atomism. It includes an explanation of such theories as quantum mechanics, energy, mass and nuclear fission. The last two chapters of this section offer a general analysis of the relation of philosophy and science. Here we find the author's brilliance fully at work. He poses penetrating questions on the relation between these two fields of knowledge. Does a philosophy of science have a right to exist, now that science has proved that it can be successful without philosophy? To this and to similar questions Professor Van Melsen concludes that physical science as such always presupposes a philosophically real background, even though many scientists may and do profess other philosophies. Science cannot escape the need for a philosophical background. The analysis of science by philosophy is an ever present need, both for the sake of philosophy and for the sake of science. Scientists who claim it is possible to reject philosophy thereby involve themselves in a philosophical discussion.

The development of physical science is the very reason why the philosophy of science is constantly in need of revaluation. Professor Van Melsen's work in this field of revaluation leaves nothing to be desired. Although the book is worthy of professional study, nevertheless it is certainly not beyond the reach of the average layman who wishes to learn both some science and some philosophy and their relationship.

Vincent F. Lackner, M.A.
Department of Philosophy
Duquesne University

History of American Psychology

• *By* A. A. ROBACK. New York: Philosophical Library, Inc. 1952. Pp. XIV + 403. $6.00.

This interesting and authoritative volume traces the 300 years of progress of American psychology from the beginnings of higher education in seventeenth century Colonial America to the present. The author skillfully unfolds the developmental and dramatic theme from a consideration of psychology as but a special division of physics, through the era characterized by emphasis on philosophy, to its contemporary recognition as an experimental science. Personal acquaintanceship with the field, its institutions, and personnel from the days of the Munsterberg laboratory at Harvard and the Titchener laboratory at Cornell permits the author to include intimate anecdotal entries.

The treatise is more than merely a handbook of schools of thought or viewpoints. It is a trend study based on analytical sifting of the contributions from American and Canadian sources, yet one which includes the historical antecedents. It is freely sprinkled with references to scholars and their premises from Aristotle to Aquinas to Freud, from antiquity to the present.

The range of content is broad enough to satisfy the student of psychology or the mature lay reader. Emphasis is placed on those data generally associated with the recent developments. Functionalism, behaviorism, the dynamic approach, the Hormic approach, the Gestalt movement, the field theories, psychoanalysis, neo-scholasticism, and factor analysis approaches are descriptively defined and associated with their chief contributors.

From a literary viewpoint, the author's experience as a psychologist and as a writer are evident. Clever use of language ranging from the scholar's manipulation of multi-syllable words and figures of speech to the news journalist's easy informal style are refreshing. Generous use of illustrations, a "Register of Personal Names," and schematic charts supplement the customary topical index.

R. Leonard, Ph.D.
School of Education
Duquesne University

Mental Prodigies

• *By* FRED BARLOW. New York: The Philosophical Library. 1952. Pp. 256. $4.75.

This genuinely interesting book will appeal especially, but by no means solely, to teachers of mathematics. It outlines the lives of a number of famous arithmetical prodigies and describes their startling accomplishments. The feats of calculation performed by these specially gifted persons are astonishing, but they appear less marvelous after Mr. Barlow has explained how some of the results may have been achieved. But one can scarcely expect a satisfactory explanation of how a boy of 17 with a mental age of two, could calculate correctly in thirty seconds the fifty-ninth power of two (an eighteen digit number).

There are chapters devoted to famous memorizers and to prodigies in chess and music and to the relationship between precocity and genius. Students will find the section on Mental Magic stimulating. In it are found a number of problems and the "magical" way in which they can be solved. The final chapters are devoted to short cuts in arithmetic and to mathematical tricks and recreations.

H. C. M.

Sun, Moon, and Planets

• *By* DR. ROY K. MARSHALL. New York: Henry Holt & Company. 1952. Pp. XII + 129. $2.50.

Written and illustrated by the distinguished scientist who is the author of "The Nature of Things" (R. THE SCIENCE COUNSELOR, March 1952), this little book will be a welcome addition to the secondary school library. Teachers and students in general science courses will find it useful. The lay reader will find in it much of interest.

Dr. Marshall writes in the pleasing, clear, nonpedantic style which he developed first in radio and later in the television programs he has presented over a Philadelphia station since 1947. The Sun and the solar system in particular are explored after the universe as a whole is considered. The story of the planets and their paths, the little planets and the meteorites is told, and there is an interesting recounting of the astronomers' most recent knowledge of the Sun and Moon and comets. A discussion of the law of gravitation and of sun spots and how they affect conditions on the earth is included.

H. C. M.

★ ★ ★ ★ ★

"If the colleges in America are to reassume the moral and ethical leadership they once possessed, the impetus, I am inclined to think, will come from the smaller institution. The larger schools are more unwieldy, less flexible, and have made much heavier commitments to technological education."

—DANIEL Z. GIBSON
President, Washington College

The Scientist's Interpreter

(Continued from Page 114)

Colman. John Kieran, author of *Introduction to Birds*, may be a familiar name to radio listeners, but through such a booklist a reader may, for the first time, make the acquaintance of the curator of the American Museum of Natural History, C. H. Curran, author of *Insects in Your Life*. One of the country's most distinguished scientists, James B. Conant, president of Harvard, has explained the methods and aims of laboratory science in *Science and Commonsense*, a book for the general reader.

Resourceful librarians and teachers have found unlimited uses for booklists. In many public libraries, *Meet the Sciences* has been made available on a "help yourself" basis, used in bulletin board displays with exhibits of books and related materials, and distributed by reader's advisors. Morris County, New Jersey, Library sent the list to schools, women's organizations and service clubs, and used it as a theme for a book talk over a local radio station. At Montclair, New Jersey, it was used by a club of teen-age boys called "The Young Scientists." The State Library of Maine distributed copies at a Maine State Teachers' Association meeting. Hammond, Indiana, Public Library, sent copies to the local high school.

Booklists, an increasingly popular form of reader guidance, are intended to help today's bewildered reader. Engulfed by the growing tide of printed material, he finds that the insistent demands of modern life have diminished his time for reading. For many whose only opportunity to visit the public library is on the lunch hour or after work, booklists are a boon. Relatively few have access to authoritative book reviews. With bookstacks open to the public, many uninformed readers select a book for its title or appearance.

A follow-up questionnaire to 20 public libraries which had distributed more than 500 copies of the 1950 edition of *Meet the Sciences* found librarians unanimous in the belief that a booklist should be limited to 50 titles. Many favored lists of 25 books. All but one believed that annotations greatly increased the effectiveness of booklists. The use of colored paper, illustrations, poetic quotations, sub-titles and unusual typography were recommended as desirable features to attract the attention of potential readers.

Reader assistance, as a function of the librarian, has developed as part of the growing concept of the public library as an institution which strives to enlighten the citizens it serves. When Dr. Conant said, "What is needed is methods for imparting some knowledge of the tactics and strategy of science to those who are not scientists,"[1] he was challenging librarians to act as interpreters for the scientists, who are daily changing the everyday world of man. ●

[1] James B. Conant, *Science nad Commonsense*, (New Haven: Yale University Press, 1951), p. 4.

About Precious Stones

(Continued from Page 137)

But if rarity combines with beauty, the desirability of a stone increases greatly. The degree of rareness accounts for the discrepancy between the cost of precious stones and their imitations. No two gems are identical, just as no two persons ever are identical.

Beauty is the essential factor for valuation of a stone. Without beauty no stone would be classified as "precious" for its rarity and fashion alone. As these three qualities increase, the value of the gem rises in proportion.

The ease with which precious stones can be shipped to every part of the world has added to their international popularity. For they can without effort be transported from one place to another.

This fact has long since established precious stones as a favorite investment commodity. Their universal security has influenced many gem buyers all over the world who realize that gem stones, just like paintings of old masters, are objects of art and that no imitation can curtail their demand.

Precious stones are a source of constant pleasure, whether they're rich rubies, fiery opals or sparkling aquamarines.

Whatever fate the future years will bring to the human race, the love of precious stones will always survive. ●

★ ★ ★ ★ ★

What is Mathematics?

(Continued from Page 124)

accepted in terms of unquestioned beliefs. These are known as postulates. Thus, the postulational procedure is not principally a matter of sheer knowledge. Were this a matter of knowledge, the system of postulates would be deprived of its meaning. True, what we know, we believe, and what we believe we assert that we know also. Thus, belief is more embracing than knowledge. But the fact that the development of a mathematical system is based on certain beliefs which are accepted in terms of faith imparts to mathematics a coloring which cannot be ignored.

The fact that mathematics must be considered from so many different angles is probably one of the basic reasons which contribute to the difficulty (if not the impossibility) of obtaining a universally acceptable definition of mathematics. We must view mathematics as a complex structure in which many and diverse factors play an important part. Thus, we are compelled to admit that any definition of mathematics is not satisfactory.

There is another phase to mathematics which is associated with the universality of its applications to other fields of human endeavor. Again, we must recognize the fact that it is not mathematics itself that is applicable. We must consider the instrumentality of the methods of mathematics, that is, the introduction of mathematics into other fields as a mode by means of which scientific and technological inquiries are facilitated. In other words, mathematics is a mere instrument which enables us to perform those tasks which by any other means are unsolvable.

Mathematics is thus revealed to us not only as a domain in which the human intellect is engaged in certain activities (we call them mathematical), but it is also an instrument which is placed in the hands of men for the purpose of lifting some of the secrets of Nature. Some have the mistaken notion that Nature is endowed with mathematical characteristics. Nature knows nothing of or about mathematics. The fact that we are able to express (and only approximately) the laws of Nature in mathematical terms should be interpreted that the Creator of Nature, in His Supreme Intelligence, devised order in His design. The intelligence of man follows the same orderliness and, by relying on fundamental beliefs, it manifests the phenomenon of this orderliness by developing mathematics. Mathematics is that instrument which enables us to lift the curtain which hides the secrets of the Creator's designs. Will man succeed in perfecting the mathematical instrument so that all the secrets will be revealed to him? probably not . . . ●

Experiences of Rock Hound

(Continued from Page 122)

cutting. It makes a mark like a pencil and doesn't rub off.

The rock hound can sometimes tell the kind of rock he is using by the way it works on the cutting or grinding wheel. The diamond saw used in cutting rock is an ordinary copper or steel disk impregnated with bort or diamond dust. Running oil is used always in cutting with a saw. A grinding wheel is wet with running water.

Personally, I am interested in both precious and semi-precious rock. I have saws for cutting and machines for grinding and polishing. I am not rich enough to engage in faceting, cutting stones like diamonds are shaped. My interest lies mostly in cabochons and in working rocks into decorative sets.

The true rock hound is a peculiar fellow. He doesn't talk about religion much, but he has faith. After sleeping under the stars in the desert and the moon in the mountains, no man is ever the same. He may hear the roar of the mountain lion or even the rattle of a snake, but he has no fear or worry. He has a deep faith. ●

★ ★ ★ ★ ★

Surface Active Agents

(Continued from Page 136)

pholine and many other compounds are found satisfactory alkalizers. The advantage of such soaps lies in the fact that the preparation is neutral in reaction, an advantage sought in shampoos and medicinal preparations for the skin. They form quick breaking emulsions. These compounds are used in rubless floor waxes and automobile waxes. When applied to a surface, the amine soap decomposes and leaves a residue of wax and fatty acid as a protective layer. ●

(To be Continued)

★ ★ ★ ★ ★

"Much teaching consists in explaining. We explain the unknown by the known, the vague by the vivid. The students usually know so little that they are delighted to hear you explain what you know and tie it up with what they are trying to understand."

—GILBERT HIGHET
The Art of Teaching

★ ★ ★ ★ ★

"A major concern of the teacher should be to provide school experiences which will introduce the pupil to a wide range of problems, the solution of which contributes to satisfactory individual and group living. The efforts to solve these problems, in school and throughout life, make for personal growth and the richness of individual life."

—ROBERT L. THORNDIKE
Columbia University

Feeding the U. S. Army

(Continued from Page 128)

of three weeks. Because it is assembled in six different menus it permits considerable variation in the diet and at the same time affords full nutritive value.

The Quartermaster Corps maintains a nation-wide system for the procurement, storage, and distribution of foods. Non-perishable foods are purchased by procurement offices in Chicago, New York, and Oakland, California. Fresh foods are bought by the Market Center System with headquarters in Chicago and market centers in nine other cities geographically located so as to be near the principal food-producing areas and in proximity to the military posts which are supplied. ●

★ ★ ★ ★ ★

"To present science as a unified, meaningful branch of knowledge requires, I believe, these two things: first, that the development of science be placed in its proper historical context; and second, that some conception be given of the whole broad scope of science."

—KONRAD B. KRAUSKOPF
The Journal of Higher Education

Science Teachers' Convention

Are you planning to attend what is expected to be the largest national convention of science teachers ever held in the United States? You should!

The convention will be held March 19, 20, and 21, 1953, under the auspices of the National Science Teachers Association at the Hotel William Penn in Pittsburgh.

Plans for the affair are already well advanced. Fourteen local committees are at work under the direction of Dr. Eugene Peckman, supervisor of science in the Pittsburgh public schools. National leadership is being provided by Mr. Arthur O. Baker, Cleveland, president N.S.T.A.; Dr. Charlotte L. Grant, Oak Park, Illinois, president elect, and Mr. Robert H. Carleton, executive secretary, Washington, D. C.

Those in attendance will be given opportunities to visit local schools, museums, and industries. Sections will be devoted to the special sciences and to elementary science. The many work groups will report at the final general session. The "Here's How I Do It" session should be extremely interesting—and helpful. There will be nationally known speakers, a "mixer," and a banquet.

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Articles are listed under author's name. Book reviews are listed under the name of the author of the book. (R) indicates a book review. The name of the reviewer follows in parenthesis.